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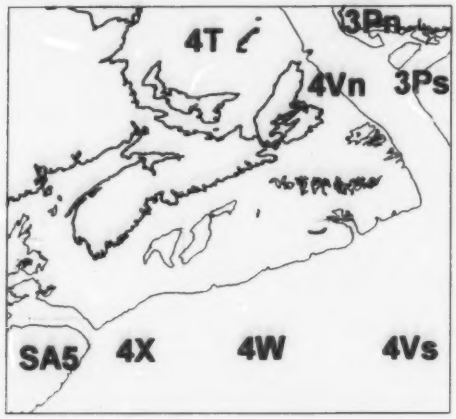
Updates on Selected Scotian Shelf Groundfish Stocks in 2001

Background

This report provides an update of stock status based on recent fishery and survey data of the following stocks: cod on the eastern Scotian Shelf (Div. 4VsW), cod on the southern Scotian Shelf and in the Bay of Fundy (Div. 4X/5Y), haddock on the southern Scotian Shelf and Bay of Fundy (Div. 4X/5Y), pollock in Div. 4VWX and SA 5Zc, silver hake on the Scotian Shelf (Div. 4VWX), Unit 3 redfish, witch flounder on the Scotian Shelf (Div. 4VWX), American plaice, yellowtail flounder, and winter flounder on the western Scotian Shelf (Div. 4X), cusk on the Scotian Shelf (Div. 4VWX), monkfish on the Scotian Shelf and northeast Georges Bank (4VWX and 5Zc), and winter skate on the eastern Scotian Shelf (4VsW). The SSR reference for the last full assessment of each stock is listed under the "Background" section of each update.

In 2001, full assessments of the following stocks, 4Vn Cod (SSR A3-02), 4VW Haddock (SSR A3-06), 4VWX White Hake (SSR A3-10), and 4VWX 3NOPs Atlantic Halibut (SSR A3-23) were also conducted.



Summary

- The two research vessel survey series for **4VsW cod** indicate continuing low abundance and have not indicated any major recruitment events in recent years. Until recruitment of several large year-classes is seen, there does not appear to be any basis to expect stock growth.

- **4X cod** survey indices for 2001 confirm the strength of the 1998 year-class and indicate that the 1999 year-class is also strong. Biomass should continue to increase under the current management plan.

- Recent recruitment for **4X haddock** has been good. Spawning stock biomass has recovered to near average levels and will likely increase slightly in 2002.

- For **4VWX5Zc pollock**, the 1997 and 1999 year-classes are moderately strong. However, catch rates and the abundance of large fish remain low. Catches at the current level of approximately 6000 t will likely permit rebuilding.

- Survey biomass for **silver hake** remains very low and total mortality is high. Recruitment prospects are mixed with the 1999 year-class above average but that of 2000 weak. The outlook for this resource remains the same – catches should not increase from those in 1997-1999.

- **Unit 3 redfish** recruitment, although promising, has not yet resulted in a detectable increase in the population biomass, but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 2002/2003 being very much the same as in recent years.

- Recruitment (<35cm) for **witch flounder** in 4VWX since 1993 continues to show an improvement over earlier periods. Survey weight per tow modestly increased from a low in 1995, but is still low relative to the long-term.

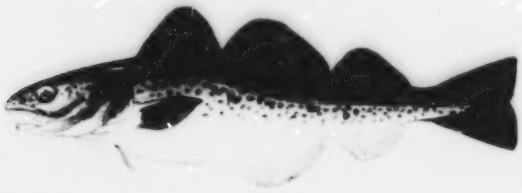
- Current information on **Western Scotian Shelf flatfish** indicates a very mixed set of stock status scenarios - a worsening situation for American plaice, an improving situation for yellowtail flounder, and relative stability in stock status of winter flounder.

- Continuing indications of stock decline are evident for **Eastern Scotian Shelf American plaice and yellowtail flounder** resources. Fishing mortality should be reduced until there is an increase in the abundance of the fishery-sized components of these populations.

- For **cusk**, it is likely that the 1000 t cap is not providing adequate restriction on catches to allow for stock rebuilding and more restrictive measures may be required.

- For **monkfish**, a continuation of the recent cautious approach to harvesting is appropriate until productivity trends and the effects of harvesting can be more accurately defined.

- For **4VsW skate**, declines in several indicators from the new information available suggest that there are increased concerns for the status of the resource.



Cod on the Eastern Scotian Shelf (Div. 4VsW)

Background

The cod (Gadus morhua) resource on the Eastern Scotian Shelf is a complex of spawning components including at least two major offshore groups (Western/Sable and Banquereau), smaller offshore groups (Middle Bank, Canso Bank) and a chain of smaller coastal spawning groups. The situation is complicated by the presence of both spring and fall spawning in several of the spawning components (Sable/Western offshore and various inshore areas).

Growth rates differ between 4Vs and 4W so that in the 1970s, fish in 4Vs reached 68cm at age 7 while in 4W reached 72cm. In the mid-1980s, growth declined in both areas and the average length at age 7 dropped to 59 and 54 cm respectively from 1985 to 1995.

The fishery for 4VsW cod was prosecuted primarily by foreign vessels until the extension of jurisdiction in 1977. Since that time, the Canadian offshore trawler fleet accounted for 70-75% of the landings and longliners most of the rest. Catches from 1958-79 were about 40-50% from 4Vs, however, as the stocks rebuilt in the early 1980s, the fishery shifted more to the east each year and 4Vs accounted for 60-80% of the landings from 1980-93.

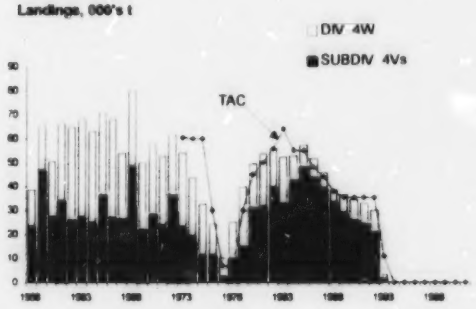
The most recent full assessment of this stock was conducted in spring 1998 (SSR A3-03 (1998)). Annual updates have been conducted since. More recent information from the fishery, research vessel and sentinel surveys is presented in this update.

The Fishery

Landings (000s t)

Year	1970-79 Avg.	1980-89 Avg.	1990-96 Avg.	1997	1998	1999[3]	2000[4]	2001[4]
TAC	43.5	43.9	16.7	0[1]	0[1]	0[1]	0[1]	0[1]
4Vs	19.8	33.3	10.7	0.1	0.1	0.3	0.1	
4W	22.3	13.2	3.8	0.2	0.2	0.1	0.1	
Total	42.1	46.6	14.5	0.3[2]	0.3[2]	0.4[2]	0.1[2]	

1. By-catch only.
2. By-catch and commercial index.
3. Fishing year, landings and TAC refer to the 15 month period from January 1, 1999 to March 31, 2000.
4. Commencing in 2000, fishing year, landings and TAC refer to the period April1 of the current year to March 31 of the following year.



The 4VsW cod fishery remains closed to directed fishing, as it has been since the fall of 1993. Catches have been taken as bycatch in other groundfish fisheries and since 1996 in the Sentinel Program commercial index. The 2001 fishing year landings, to October 24, are 64t. Detailed historical information on the cod fishery is available in Mohn *et al.* (1998).

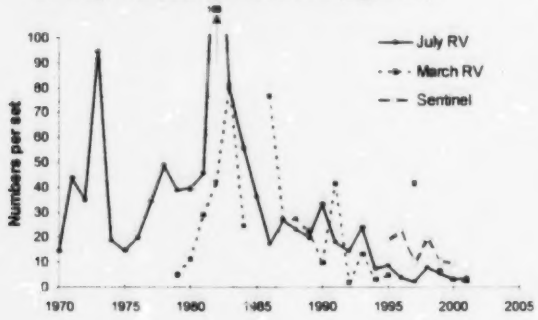
Resource Status

Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2001).

The abundance indicators from the most recent surveys all remain low with respect to their series. In particular, the large 1997 estimate from the March survey stands out as an anomaly, not representative of abundance. In 1999, 2000 and 2001, the March and July

survey results for each year are virtually indistinguishable.

Survey indices in 4VsW cod (ages 3+).



Outlook

The two research vessel survey series indicate continuing low abundance and have not indicated any major recruitment events in recent years. Until recruitment of several large year-classes is seen, there does not appear to be any basis to expect stock growth.

The outlook from the last Stock Status Reports (DFO, 1998a, 1999 and 2000) for this stock, based on assessment of the stock (Mohn *et al.*, 1998) included the following:

> "The short-term prospects for this fishery remain dismal. The productivity of the stock is very low, there are several factors causing increased mortality overall as well as seal predation on the younger age groups. The spawning stock biomass, while not declining, has not rebuilt since the closure of the fishery."

The new information available since then does not suggest that the above outlook need be revised.

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References

Branton, R., and G. Black. 2001. 2001 Summer groundfish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

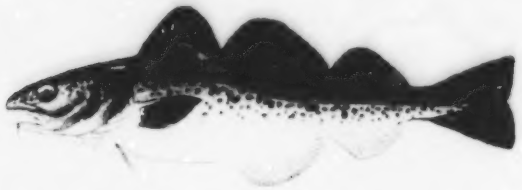
DFO, 1998a. Eastern Scotian Shelf Cod. DFO Sci. Stock Status Report. A3-03(1998).

DFO, 1998b. Updates on Selected Scotian Shelf Groundfish Stocks in 1998. DFO Sci. Stock Status Report A3-35(1998).

DFO, 1999. Updates on Selected Scotian Shelf Groundfish Stocks in 1999. DFO Sci. Stock Status Report A3-35(1999).

DFO, 2000. Updates on Selected Scotian Shelf Groundfish Stocks in 2000. DFO Sci. Stock Status Report A3-35(2000).

Mohn R.K., L.P. Fanning, and W. J. MacEachern. 1998. Assessment of 4VsW cod in 1997 incorporating additional sources of mortality. DFO. Atl. Fish. Res. Doc. 98/78.



Cod on the Southern Scotian Shelf and in the Bay of Fundy (Div. 4X/5Y)

Background

Atlantic cod (Gadus morhua) is a bottom dwelling fish occurring on both sides of the North Atlantic. In the Canadian Atlantic, cod range from northern Georges Bank to northern Labrador. There are several concentrations of cod within this range, including those on the southern Scotian Shelf and Bay of Fundy (NAFO Division 4X and Canadian portions of 5Y).

Juvenile cod feed on a wide variety of invertebrates, with fish entering their diet as they grow. Seasonal movements associated with spawning occur and a number of spawning grounds exist in this management area, with the largest occurring during winter on Browns Bank. Cod in this area reach on average 53 cm (21 in.) by age 3, and increase to 72 cm (29 in.) by age 5 and 110 cm (43 in.) by age 10. Growth rates vary, however, with more rapid growth noted for cod in the Bay of Fundy. Age at first reproduction is generally 3 years; individuals tend to spawn several times during a single spawning period.

Cod has supported a commercial fishery in this area since the 1700s and until the 1960s was primarily an inshore fishery. Following extension of jurisdiction to 200 miles by coastal states in 1977, only Canada has made substantial landings of cod from this area. Minimum mesh size and hook size regulations have been enacted to reduce the catch of juvenile cod. Closure of Browns Bank is in place from 1 February-15 June.

The most recent full assessment of this stock was conducted in fall, 2000 (SSR A3-05 (2000)). More recent information from the fishery, commercial port samples, the research vessel and ITQ survey is presented in this update.

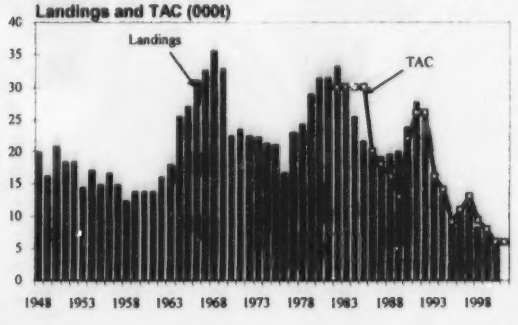
The Fishery

Landings (000s t)

Year	1970-'79 Avg.	1980-'89 Avg.	1990-'96 Avg.	1997	1998	1999[1]	2000[2]	2001
TAC	-	23.4	17.7	13	9.3	7.9	6.0	6.0
Total	22.5	24.9	11	11.5	8.2	7.4	6.0	

1. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refers to the period April 1 of the current year to March 31 of the following year.

Landings increased through the 1960s from 14,000t to 36,000t as large offshore trawlers became active in the fishery. The total allowable catch (TAC) and landings declined throughout the 1990s, and were the lowest on record in 2000. Recent decreases in landings are primarily a reflection of the TAC, which declined from 26,000t in 1992 to 6,000t in 2000. A total of 4,100t of the 2001 quota were landed by October 24, with 81% of the fixed gear quota already landed. Fishermen indicate that in 2000, the traditional groundfish fishery (cod, haddock and pollock) was constrained by both cod and white hake, whilst in 2001 cod quota has been the main constraint.



The fishery takes place year round, peaking in June and July. Landings from the winter fishery declined after 1992, with many fishing sectors treating cod as a bycatch as they pursued other species. Since 2000, the quota year has run from April 1st. With this change in fishing year, and the increase in haddock quotas relative to cod, the winter

fishery has increased. In recent years, some cod quota has been saved to allow fishing for haddock in January, February and March.

In 2000 and 2001, cod fishing was reported to be good in most areas. Most industry associations reported no difficulty in catching their quota despite the fact that many were directing their effort primarily for haddock. Hook and line vessels in the Bay of Fundy caught their quotas in 2001; this is the first time they have done so in 4 years. Fishing in inshore areas of 4Xo, however, was poor, with fishermen having to travel further offshore to catch cod.

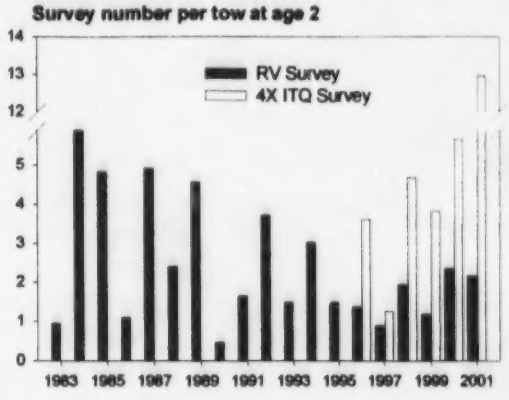
In 2000, the 1996 year-class accounted for 40% of the 4X cod landings. Age 2 (the 1998 year-class) comprised a higher than average proportion of the catch, and the contribution from ages 6+ was about average. In 2001, length frequencies from the commercial fishery indicate that the 1998 year-class is dominant in the landings, as predicted in 2000.

A stock recovery plan, which has fixed the quota at 6,000t annually, will enter its third year in 2002.

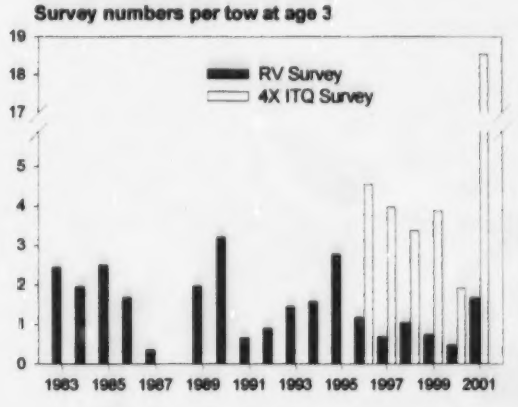
Resource Status

Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2001).

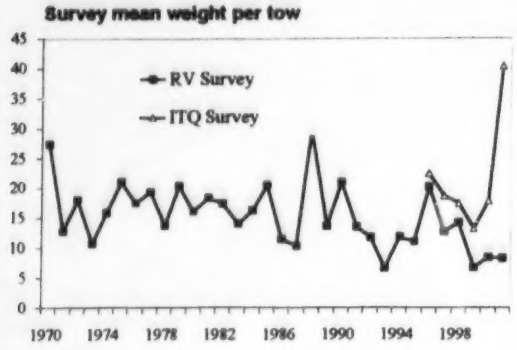
The 2000 assessment indicated that biomass growth for this stock was dependent on **recruitment**. Thus the main focus of this review is to evaluate the most up-to-date information on year-class strength. Recruitment prospects based on the catch of the 1999 year-ciass at age 2 in the 4X ITQ and research vessel (RV) surveys appear positive, with catches similar to, or better than, the 1998 year-class in the 2000 surveys.



The 1998 year-class at age 3 is above average in both surveys and considerably higher than any year-class since the 1992.



The total catch per tow (kg) for the **RV survey** in 2001 was unchanged from 2000. The catch for the 4X **ITQ** survey more than doubled from 2000 to 2001.



While some increase was seen in inshore areas and on the Scotian Shelf, catches of cod in the Bay of Fundy accounted for 80% of the total for the 4X ITQ survey.

Outlook

The 2000 assessment indicated that if the 1998 year-class was as strong as suggested by indices at age 2, and the 1999 year-class was equally strong, the rebuilding objective for this stock could be met by 2003. Survey indices for 2001 confirm the strength of the 1998 year-class, and indicate that the 1999 year-class is also strong. These two year-classes will begin contributing to the age 4+ biomass in 2002. While the RV index for total biomass did not increase from 2000 to 2001, this is not inconsistent with the biomass projection from the 2000 assessment. Biomass should, therefore, continue to increase for this stock under the current management plan.

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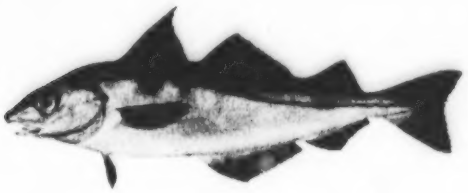
References

Branton, R., and G. Black. 2001. 2001 Summer Groundfish Survey Update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

Clark, D. S., S. Gavaris, and S. D. Paul. 2000. Assessment of cod in Division 4X in 2000. Can. Stock Assess. Sec. Res. Doc. 2000/139.

DFO, 2000. Southern Scotian Shelf and Bay of Fundy Cod (Div. 4X/5Y). DFO Sci. Stock Status Report A3-05(2000).



Haddock on the Southern Scotian Shelf and Bay of Fundy (Div. 4X/5Y)

Background

Haddock (Melanogrammus aeglefinus) are found on both sides of the North Atlantic. In the west Atlantic, they occur from southwest Greenland to Cape Hatteras. A major stock exists in the southern Scotian Shelf and Bay of Fundy area. This bottom-dwelling species is a member of the cod family and feeds mainly on small invertebrates. It is most common at depths of 25-75 fathoms (46-137 m) and in bottom temperatures above 2°C. Although seasonal migrations are evident within the stock area, there is relatively little exchange between adjacent haddock stocks.

Young haddock in this stock are relatively fast growing, reaching 17 inches (43 cm) and 1.7 pounds (0.8 kg) by age 3 on average. Growth slows thereafter and haddock reach only about 26 inches (66 cm) in length by age 10. Haddock in the Bay of Fundy grow more rapidly than those on the southern Scotian Shelf. Approximately 50% of female haddock are mature by age 3; however the number of eggs produced by a female of this age is low and increases dramatically with age. Browns Bank is the major spawning area for the stock and peak spawning may occur from April to June

Reported annual landings have been as high as 43,000t and the long-term average is about 18,000t. Landings have been below 11,000t since 1988. Historically this fishery has been dominated by mobile gear except during 1990-93 when the proportion of landings taken by fixed gear was greater. Quotas for this stock were introduced in 1970 and a spawning season/area closure has been in place since that time.

The most recent full assessment of this stock was conducted in fall 1999 (SSR A3-07(1999)). An update was conducted in fall 2000. More recent information from the fishery, commercial port samples, and the research vessel and ITQ surveys is presented in this update.

The Fishery

Landings (000s t)

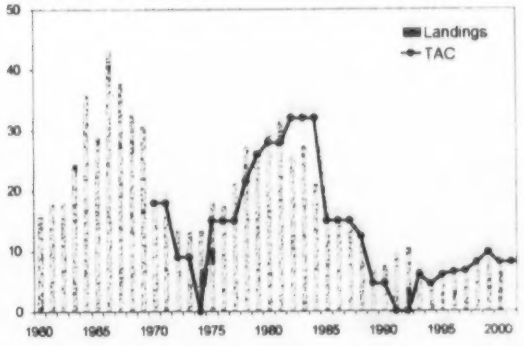
Year	1970-79 Avg.	1980-89 Avg.	1990-96 Avg.	1997	1998	1999[1]	2000[2]	2001[2]
TAC	14.7	21.4	3.9	6.7	8.1	9.8	8.1	8.1
TOTAL	18.6	19.6	7.3	6.5	7.8	9.2	7.9	

1. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

Reported **landings** of 4X haddock in the fishing year ending March 31, 2001 were 7,945t. Haddock landings for the current fishing year to October 24, 2001, were 4,170t. This fishing year is proceeding much like the last. Although most fishermen are attempting to avoid catching cod, 67% of the overall cod quota had been landed by October 24, while only 51% of the haddock quota had been landed.

Haddock landings during the first quarter of 2001 were the highest since 1991. Both the fixed gear and mobile gear sectors indicated this was due primarily to the ability to direct for haddock with a minimal bycatch of cod at that time of year.

Landings and TAC (000s t)



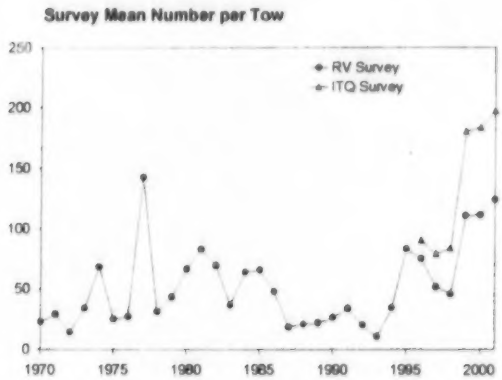
Reports from industry indicate that haddock abundance was good throughout most of the stock area in 2000 and 2001. Catches of small fish were prevalent, particularly in eastern 4X. Industry reports indicated they felt that discarding of small

haddock was low in 2000 and 2001 due to improved prices for small fish.

Resource Status

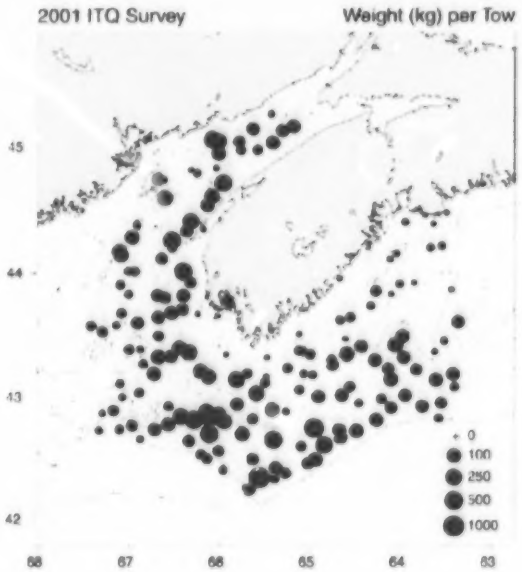
Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2001).

Abundance in the **summer DFO research vessel survey** was high in 1999 and 2000, and increased again in 2001 due to large catches of age 1, 2 and 3 haddock. Catches of these age groups were widespread in the survey area.



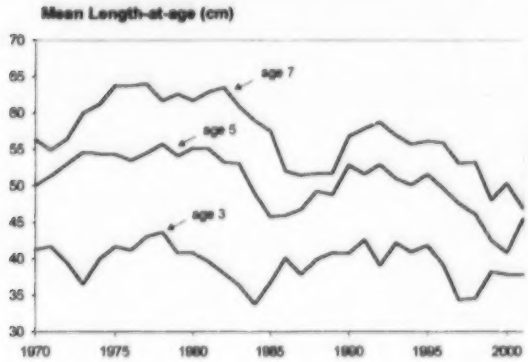
Catches of commercial-size (>43cm) haddock in the research vessel survey increased in 2001 to the long-term mean.

A joint industry/DFO Science resource survey of 4X was conducted in summer 1995-2001 by the **ITQ** fleet. Survey coverage has increased to 187 standardised fishing sets and now covers most of the 4X area. In addition to providing extensive coverage of the traditional research vessel survey strata, this survey provides coverage inshore of the traditional strata in an area where a substantial portion of the mobile gear fishery occurs. Haddock were widespread throughout the survey area again in 2001 and abundance was high. It was decided that the 1995 survey point would not be used as an index of abundance, due to a number of differences in the survey in that developmental year.

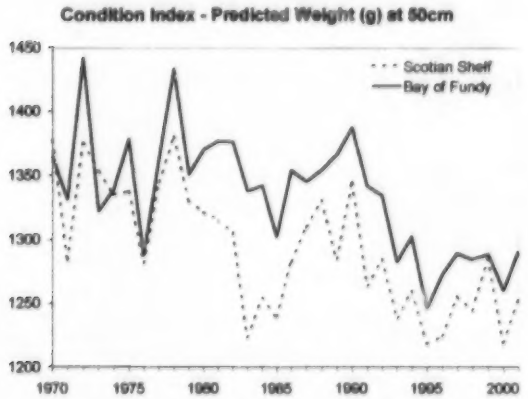


Total mortality estimated for ages 5-7 from the summer research vessel surveys was relatively stable in recent years and implied fishing mortality of about $F_{0.1}$.

Mean lengths-at-age in the research vessel survey have been decreasing through the 1990s, particularly at older ages. Mean weights-at-age show similar trends. Most ages are below the long-term mean length and weight and some are at the smallest size observed in the research vessel survey series. There have been some recent increases at younger ages.



Condition is the relative weight of the fish for their length (i.e. their plumpness). An index of condition, developed from the summer research vessel surveys, was variable but indicated that condition decreased since the late 1980s and reached a minimum in 1995. This index has increased since but remains below the long term mean. The attributes, condition and fish size, are thought to be related to spawning potential.



A measure of **resource concentration** is the proportion of the historical stock area encompassing 75% of the annually estimated survey biomass. This index has been increasing since 1989 and is near the highest observed, indicating that the resource is widely distributed.

The proportion of annual survey sets where a species occurs (non-zero sets) is a measure of the **area occupied** by the species. This index has been increasing since 1989 and is presently at a high level.

The research vessel survey and the ITQ survey indicate that the 1997 year-class is above average and that the 1998, 1999 and 2000 year-classes are strong.

Summary of Attributes of Stock Status

Attribute	Recent trend	Current Status
Abundance RV number/tow 1970-2001	Increasing	Near highest observed
Total mortality RV ages 5-7 1970-2001	Stable	Near average
Mean Length RV age 5 1970-2001	Variable	Near lowest observed
Condition RV 1970-2001	Variable	Below average
Resource concentration	Increasing	Widely distributed
Area occupied	Stable	Widely distributed

Outlook

The outlook from the last Stock Status Report for this stock (DFO, 1999) indicated that the resource was rebuilding, due to a number of strong year-classes and recent exploitation levels at or slightly below the target level. Spawning stock biomass was near average levels but was projected to decrease unless further strong recruitment occurs. There are indications from the surveys that the 1998, 1999, and 2000 year-classes are strong. All age classes are widely distributed, a condition usually associated with high abundance in this resource. Fish condition and mean fish size are currently low.

Exploitation in 1999 and 2000 was likely near the target and will likely be again in 2001 if the quota is not exceeded.

Therefore our view of current stock status is unchanged. The projections of yield and spawning stock biomass made in the last assessment are still applicable. That assessment indicated that the $F_{0.1}$ yield in the fishing years commencing April 1st in 2001 and 2002 would be 8,600t in both years. Spawning stock biomass would increase to 39,000t in 2001 and decrease slightly to 37,000t in 2002 at those exploitation levels. That projection assumed average recruitment. However, the 1998 and 1999 year-classes are confirmed to be large and thus an increase in spawning stock biomass in 2002 would be expected.

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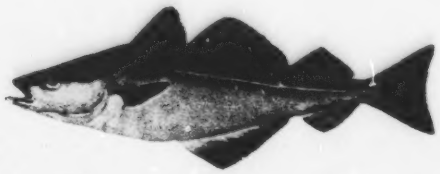
References

Branton, R., and G. Black. 2001. 2001 summer groundfish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 1999. Southern Scotian Shelf and Bay of Fundy Haddock. DFO Sci. Stock Status Report A3-07(1999).

DFO, 2000. Updates of selected Scotian Shelf groundfish stocks in 2000. DFO Sci. Stock Status Report A3-35(2000).

Hurley, P.C.F., G.A.P. Black, P.A. Comeau, and R.K. Mohn. 1999. Assessment of 4X haddock in 1998 and the first half of 1999. DFO Canadian Stock Assessment Secretariat Res. Doc. 99/147.



Pollock in Div. 4VWX and SA 5Zc

Background

Pollock (Pollachius virens) in the western Atlantic range from southern Labrador to about Cape Hatteras. The main fishable concentrations occur in the Georges Bank, Gulf of Maine, and Scotian Shelf areas.

Young pollock are closely associated with nearshore habitats, recruiting to the offshore populations at around age 2. Based on observations by fishermen and acoustic studies, pollock spend the least time on the bottom of all the cod-like fish. Pollock show strong schooling behaviour. Food of adult pollock include euphausiids and fish such as herring, sand lance and silver hake.

Pollock are mature at ages 3 to 5 depending on the area. Pollock also show marked differences in growth rate by area, with fish in the Bay of Fundy area growing faster than those on the eastern Scotian Shelf.

The management unit includes the Canadian portion of Georges Bank and the Gulf of Maine, and the Scotian Shelf. A variety of fishing gear is used to fish pollock, primarily otter trawls and gillnets, but also includes handlines and longlines. The otter trawl and gillnet fisheries are often directed. Pollock can also be taken as bycatch in cod and haddock fisheries and in the small-mesh silver hake and redfish fisheries.

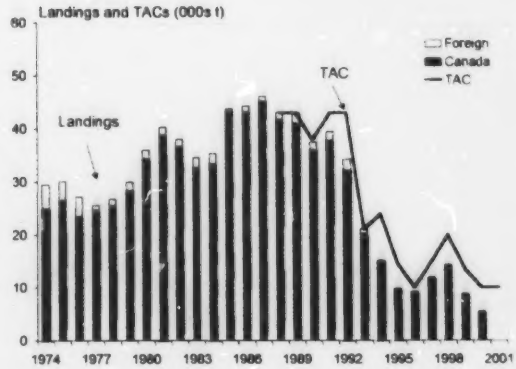
The most recent full assessment of this stock was conducted in fall 1999 (Neilson *et al.* 1999, SSR A3-13 (1999)). An update was conducted in fall 2000 (DFO (2000)). More recent information from the fishery, commercial port samples, the research vessel and ITQ surveys is presented in this update.

The Fishery

Landings (000s t)

Year	1980-89 Avg.	1990-96 Avg.	1997	1998	1999[1]	2000[2]	2001
TAC	-	27.6	15.0	20.0	13.4	10.0	10.0
TOTAL	40.5	23.8	12.0	14.4	8.9	5.5	

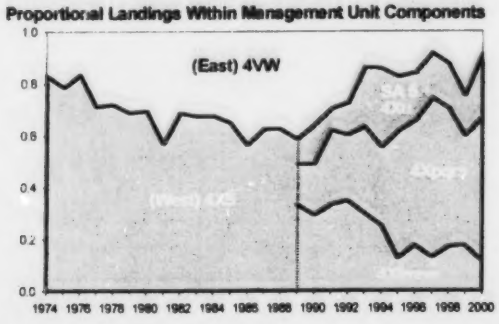
1. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refers to the period April 1 of the current year to March 31 of the following year.



Landings for the fishing year April 1, 2000 to March 31, 2001 were 5507t. Landings in the current fishing year are 4459t (includes those landings from April 1st through Oct. 24th).

The pollock fishery continues to undergo significant changes in both area fished and in dominant gear type. The western (4X5) half of the management unit usually contributes the largest proportion to total landings. The eastern (4VW) contribution was 9% in 2000. Within 4X5, the proportion of landings from the western half (Unit Areas 4Xpqrs) has increased from 29% in 1991 to 55% in 2000. The changes in the distribution of the fishery were thought to reflect both the population dynamics of the stock and fishery management measures. During periods of lower landings (early 1970s and the present period), the contribution from the east is lower, suggesting greater reductions in

abundance. In the present period, the east is closed to cod-directed fishing, which further reduces pollock landings from that area.

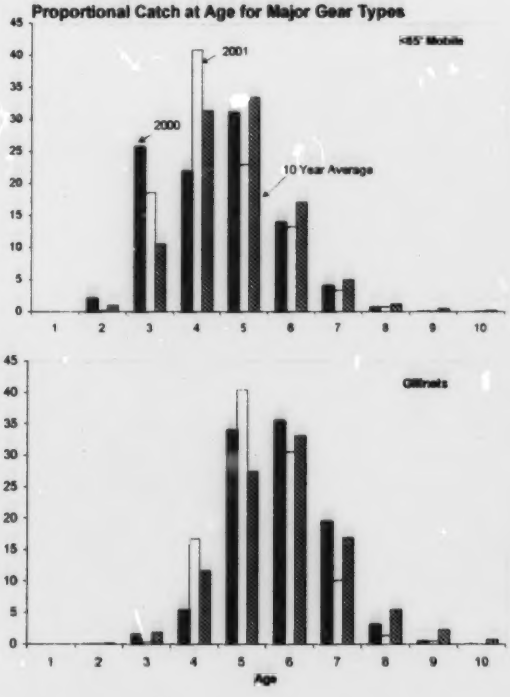


The contribution of larger trawlers to total landings (Tonnage Class (TC) 4+), once the dominant gear type in the fishery, has been steadily declining since 1981 and accounted for 16% of total removals in 2000. In contrast, the contributions of TC 1-3 trawlers and fixed gear vessels (gillnet, longline) have been increasing over the same period and now account for 42 and 41% of the total landings, respectively.

During **industry consultations** in September/October 2001, fishermen reported a varied experience with the fishery depending on what gear sector they belonged to. Effort directed towards pollock by larger mobile gear (>100') was low in 2001, as that fleet directed most of their resources towards redfish and Greenland halibut. Mobile gear (< 65') fishermen reported catch rates ranging from "improved from last year" to "poor". Handliners in the Bay of Fundy indicated that their fishery was poorer than in 2000. Gillnet fishermen consistently reported an improved fishery in 2001 compared with 2000. Further, they noted a broader range of sizes in the catch, and the occurrence of fish in traditional areas. All sectors commented that small pollock were plentiful.

Last year, there was a considerable shortfall in landings compared with the TAC. Industry consultations in 2000 gave the impression that the low catches were related, in part, to reduced market prices for pollock and white hake and cod bycatch restrictions. Such considerations were again noted in the 2001 consultations, but white hake bycatch restrictions were considered less of an impediment to the pollock fishery.

The landings in the small (<65') mobile gear fishery in 2000 and 2001 typically consisted of ages 3-6, and ages comprising most of the gillnet fishery landings are 4-7. The 1997 year-class is noteworthy at age 4 in 2001, compared with the 1996 year-class at age 4 in 2000. Ages 8 and 9 comprise a smaller proportion of the gillnet landings in 2000 and 2001 compared with the average from 1990 to 1999.

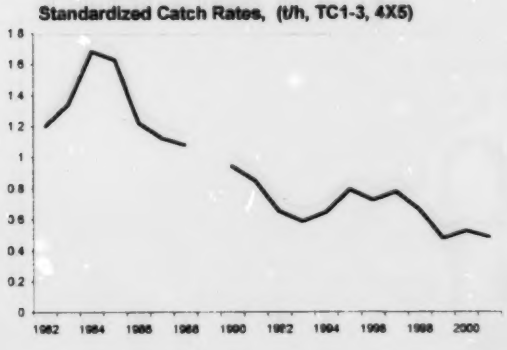


Resource Status

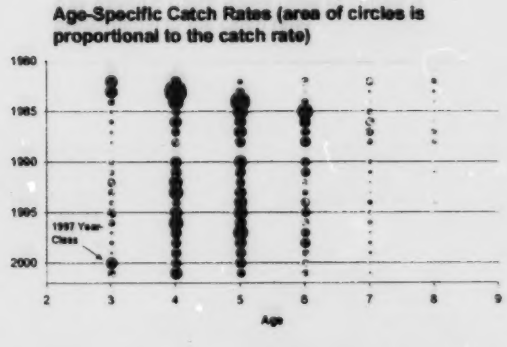
The index of abundance used in this assessment is a **standardized catch rate series** that uses data from directed pollock

trips of TC 1-3 otter trawlers operating in 4X5. The standardized catch rate series accounts for differences in catch rate by vessel tonnage class, mesh type, unit area, month and year.

The catch rate series peaked in 1984 as the strong 1979 year-class became fully recruited, and declined thereafter. Landings during that period were at their highest level historically. After a slight increase from 1993 to 1995, the catch rate series decreased.



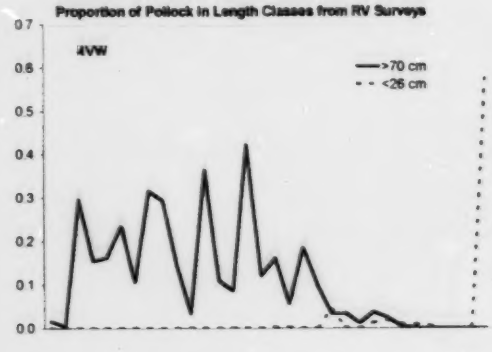
Catch rates in 2001 (as of Aug. 31) remain at a low level, comparable to 1999 and 2000. The age-specific mobile gear catch rate was dominated by the moderately strong 1997 year-class.

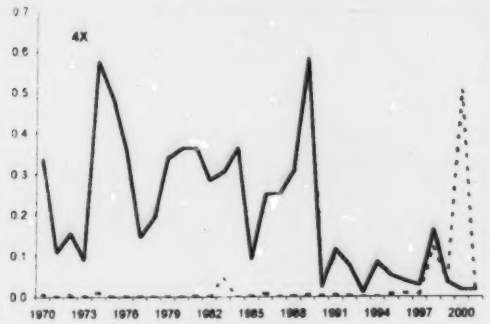


Information on the annual spatial distribution and size composition from the **July research vessel surveys** is provided in Branton and Black (2001). Such data are not currently used as an index of abundance in this assessment, because there is considerable unexplained interannual variation of many year-classes, which is inconsistent with our knowledge of fisheries dynamics. However, the research survey information on **size structure** indicates fewer larger (> 70 cm) fish in the surveys since 1990, for both the eastern (4VW) and western (4X) halves. The absence of larger fish is probably attributable to relatively high exploitation rates during the early 1990s (Neilson *et al.* 1999).

Recent surveys (1998 to 2000) have caught more small pollock (<26 cm) in 4X than in previous years. This was particularly noteworthy in 2000. Those fish are one year old (estimated by length as the 1998 year-class in DFO (2000), but otolith ages indicate the 1999 year-class). The 1999 year-class was also apparent in the 2001 survey.

The 2001 survey also caught many more small (<26 cm) pollock than in previous years. In contrast to the 2000 survey where most of the fish <26 cm were found widely distributed in the Bay of Fundy, the small fish were found on the Eastern Scotian Shelf in 2001, mainly in a single large set.





A joint industry/DFO Science survey conducted by the **ITQ fleet** in 4X also indicated fewer fish >70 cm in 1999 to 2001 compared with 1995 to 1998. In 2000, large numbers of 20-25 cm (age 1, 1999 year-class) fish were seen compared with previous years, and appeared in 2001 as 30-35 cm fish.

Outlook

The Outlook from the 1999 Stock Status Report noted:

> "In summary, the pollock resource remains depleted,....biomass is less than average, recent recruitment has been poor, there is an absence of older fish in the population, and there are spatial changes in the resource and in the fishery distributions that are worrisome. Caution in establishing harvest levels is required."

In the 2000 review, it was noted that while there were preliminary indications of improved recruitment from the fishery, catch rates remained comparatively low, large fish were rare in the catch and the surveys, and the fishery remained spatially constricted. It was noted that the TAC for the 2000-2001 fishery of 10,000t exceeded the $F_{0.1}$ level of 7,000t. Had that TAC been caught, it would have probably resulted in excessive mortality on older ages of pollock, currently considered to be at low abundance.

The new data available for the 2001 review indicates that the 1997 year-class is moderately strong and is recruiting to the fishery. The 1999 year-class may also be stronger than recent year-classes. However, catch rates and the abundance of larger fish remain low. Catches at the current level of approximately 6,000 t will likely permit rebuilding.

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References

Branton, R., and G. Black. 2001. 2001 summer groundfish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

Clark, D., J. Neilson, P. Hurley, P. Perley, and M. Fowler. 1998. Shifts in fishing effort, commercial landings and resource distribution for cod, haddock, pollock and white hake in NAFO Division 4X. DFO Canadian Stock Assessment Secretariat. Res. Doc. 98/58.

DFO, 2000. Updates on selected Scotian Shelf Groundfish Stocks in 2000. DFO Science Stock Status Report A3-35(2000).

Neilson, J., P. Perley, and C. Nelson. 1999. The 1999 assessment of pollock

(*Pollachius virens*) in NAFO Divisions 4VWX and Subdivision 5Zc. DFO Canadian Stock Assessment Secretariat Res. Doc. 99/160.

Silver Hake on the Scotian Shelf (Div. 4VWX)

Background

Silver hake (Merluccius bilinearis) is a bottom dwelling member of the gadoid family, found from Cape Hatteras to the Grand Banks and the Gulf of St. Lawrence. A major concentration of silver hake occurs on the Scotian Shelf.

Scotian Shelf silver hake are generally found between 7 and 10° C, in deeper water on the shelf edge and in the Emerald and LaHave basins. Seasonal movements occur during the summer, as silver hake move into shallow water on Sable and Western banks to spawn. Scotian Shelf silver hake feed primarily on invertebrates, with krill the predominant prey item. Older fish are piscivorous and exhibit a high degree of cannibalism.

Silver hake exhibit relatively rapid growth with females growing faster than males. Maximum age is 12 years. Maturity is relatively early, with a majority of males maturing at age 2, and females at 3.

Prior to 1977, fishing on the Scotian Shelf was unrestricted in terms of area, mesh size and season. During this period fishing was conducted over the entire shelf, and the use of trawl mesh as small as 40 mm was common. In 1977, fishing for this species was restricted to the seaward side of the Small Mesh Gear Line (SMGL), west of 60° W longitude, with a minimum mesh size of 60 mm (offshore). In 1994, further restrictions were introduced to minimise incidental catches of cod, haddock and pollock in the silver hake fishery. These included a repositioning of the SMGL to prevent fishing in depths less than 190 m and the mandatory use of a separator grate in the lengthening piece of the trawl. Since 1995 a fishery has been conducted by the Canadian tonnage class 3 (<65') mobile gear fleet in and around Emerald and LaHave Basins (inshore).

The most recent assessment of this stock was conducted in fall 1999 (SSR A3-09 (1999). An update was conducted in the fall of 2000 (SSR A3-35 (2000)). More recent landings data and information from the summer research vessel survey are presented in this update.

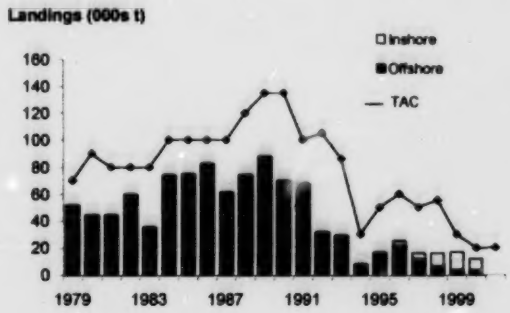
The Fishery

Landings (000s t)

Year	1970-79 Avg.	1980-89 Avg.	1990-96 Avg.	1997	1998	1999[2]	2000[3]	2001
TAC	90.2[4]	98.5	56.6	50	55	33	20	20
Canada[1]	0	0	0.6	16.3	16.1	16.7	12.9	
Foreign	115.6	64.2	34.8	0.7	0	0	0	
Total	115.6	64.2	35.4	17.0	16.1	16.7	12.9	

1. Includes developmental allocations.
2. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.
3. Commencing in 2000, fishing year, landings and TAC refer to the period from April 1 of the current year to March 31 of the following year.
4. Average TAC for 1974-79 period

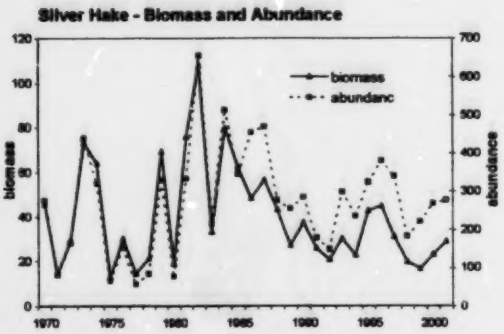
Landings for the 2001 fishing year (to October 24th) are 11,700t, for which the offshore developmental portion is 1,900t.



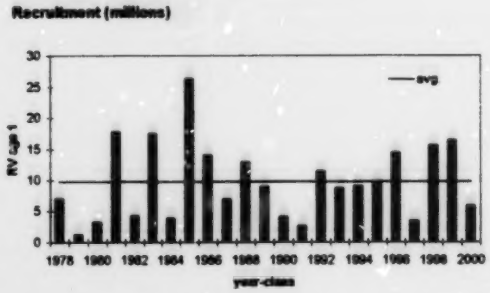
Resource Status

Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2001).

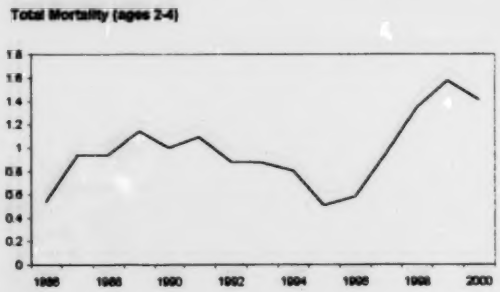
Abundance and biomass from the DFO **summer research vessel (RV) survey** show a slight increase since 1999, but remain low relative to the long term mean.



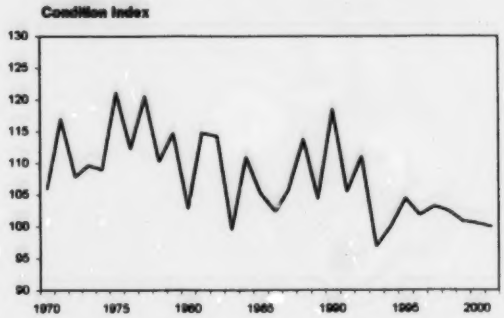
Recruitment to the 2001/2002 fishery is from the 1999 and 2000 year-classes. The 1999 year-class is above average, while the 2000 year-class is below average.



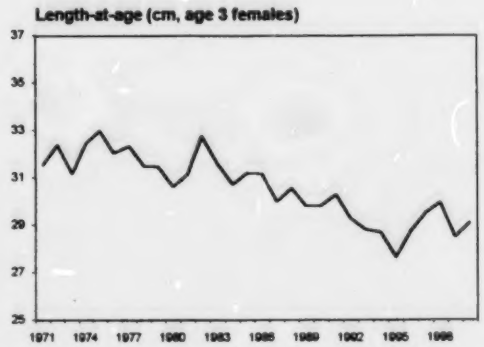
Total mortality over ages 2-4 from the summer survey shows an increasing trend since 1995. Total mortality for ages important to the fishery is above that expected with $F_{0.1}$ = 0.7 (assuming natural mortality = 0.4), suggesting exploitation is relatively high despite moderate catches.



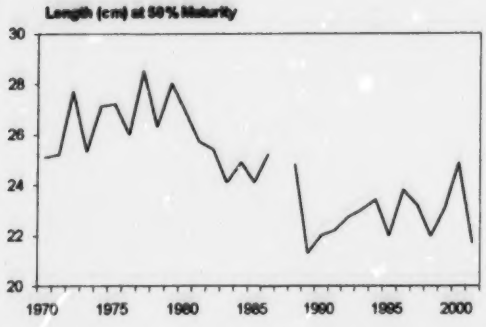
There are long-term declining trends in biological indicators. **Condition** (weight at 25cm), shows a general decline from 1975 to 1993. An increase was seen in 1995, but condition has declined subsequently to a low level relative to the long-term average.



Length-at-age has also shown declines, from high levels in the early 1970s to a low in 1995. Length-at-age increased from 1995 to 1998, but declined subsequently and remains just below the long-term mean.



Length at 50% maturity has declined since the late 1970s. While there has been some increase since the late 1980s, it remains low.



A measure of **resource concentration** is the proportion of the historical stock area encompassing 75% of the annually estimated survey biomass. For silver hake this index has increased since 1992, and is near the highest observed, indicating that the resource is widely distributed.

The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the **area occupied** by the species. This index has been increasing since 1992 and is presently at a high level.

Summary of Attributes of Stock Status

Attribute	Recent Trend	Current Status
Biomass RV age 1+ (1970-2001)	Increasing slightly since 1999.	At low level.
Recruitment RV age 1 (1979-2001)	None	1999 year-class above average; 2000 year-class below average
Total mortality RV ages 2-4 (1983-99)	Increasing since 1995.	F is above $F_{0.1}$ if M=0.4.
Condition (1970-2001)	Declining since 1995	Low relative to long-term average.
Length at age (1971-2000)	Stable.	Low relative to long-term average.
Length at maturity (1970-2001)	Stable.	Low relative to long-term average.
Resource concentration (1970-2001)	Increasing	Widely distributed.
Area occupied (1970-2001)	Stable	Widely distributed.

Outlook

The outlook from the last full assessment for this resource indicated that catches should not be allowed to increase from 1997-99 levels.

Survey biomass remains very low and total mortality is high. The extreme values of these important indicators cause substantial concern. In addition, condition, length-at-age, and size at maturity are below long-term averages.

Recruitment prospects are mixed, with the 1999 year-class above average but that of 2000 weak. Resource concentration and distribution through the geographical range exhibit positive trends.

Given the inconsistency of available attributes of stock status for this resource, the outlook remains the same – catches should not increase from those in 1997-1999.

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References

Branton, R., and G. Black. 2001. 2001 summer groundfish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 1999. Scotian Shelf Silver Hake. DFO Science Stock Status Report A3-09(1999).

DFO, 2000. Updates on selected Scotian Shelf stocks in 2000. DFO Science Stock Status Report A3-35(2000).

Showell, M.A., and L.P. Fanning. 1999. Assessment of the Scotian Shelf silver hake population in 1998. DFO. Can. Stock Assessment Secretariat Res. Doc. 99/148.

Unit 3 Redfish

Background

Redfish, also known as ocean perch, occur on both sides of the Atlantic Ocean. They are normally found along the slopes of fishing banks and deep channels usually at 100 - 700 m in water of 3 to 8 °C. In the northwest Atlantic, redfish range from Baffin Island in the north to New Jersey in the south. The predominant species on the Scotian Shelf are Sebastes fasciatus (Acadian redfish), occurring in the deep basins and at the edge of the continental shelf, and S. mentella (beaked redfish) occurring in the deeper waters off the continental shelf. Differences between these two species are not readily apparent, therefore commercial and research catch are not routinely separated by species. Recent genetic research results confirm that Unit 3 redfish are almost exclusively S. fasciatus and belong to a separate stock from S. fasciatus in Units 1 and 2. There is also an indication of a genetic separation between Scotian Shelf and Gulf of Maine populations. While this genetic information provides important insights on stock structure, additional research is required, before its full implications are understood.

The Unit 3 management area (4WdehklX) for redfish was first implemented in the 1993 Groundfish Management Plan with a quota of 10,000 t. Redfish in this area were previously managed as part of a larger 4VWX management area. Redfish in Unit 3 are primarily caught by otter trawlers using 90 mm mesh. Regulations limit the bycatch in NAFO division 4X of other groundfish species to 10 % by weight of redfish caught and the bycatch in NAFO divisions 4VW to 2 % by weight each of cod and haddock.

The most recent full assessment of this stock was conducted in fall 1999 (SSR A1-01 (1999)). An update was conducted in fall 2000. More recent information for the fishery and summer research vessel survey is presented in this update.

The Fishery

Landings (000s t)

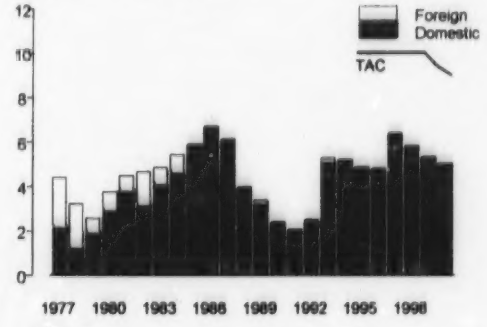
Year	1980-89 Avg.	1990-96 Avg.	1997	1998	1999[1]	2000[2]	2001[2]
TAC	--	--	10.0	10.0	9.4	9.0	9.0
Total	5.4	4.2	6.4	5.8	5.3	5.0	

1 1999 TAC and landings refer to the 15 month period from Jan 1, 1999 to March 31, 2000.

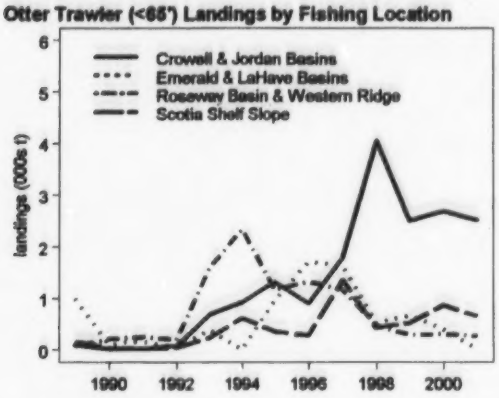
2 Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

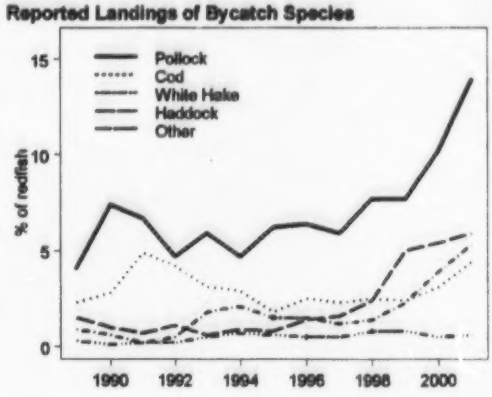
Redfish landings gradually increased from the late 1970s, peaking at almost 7,000t in 1986 followed by a decline to about 2,000t in 1991. Landings peaked again in 1997 at about 6,000t. Landings for 1998 were about 5,800t, well below the 10,000t TAC. In 1999, the TAC although reduced to 9,000t, was prorated to a 15-month TAC of 9,400t allowing transition to a 12 month fishing year starting April 1, 2000. Total landings for this 15 month 1999 period was 5,300t. Total landings for the 12 month period April 2000 to March 2001 was 5,000t. Total 2001 landings (April 1 to October 24) was 3,000t.

Landings and TAC (000s t)



Since 1998, otter trawlers (<65'), fishing almost entirely in the Crowell and Jordan basin portions of the Gulf of Maine, took most of the reported landings.





Since 1996, 22 cm has been used as the **minimum size** in Conservation Harvesting Plans. Percentages by number of redfish landings under this size were:

1993	1994	1995	1996	1997	1998	1999	2000	2001 (to Oct)
4	15	15	10	6	7	11	9	14

Following an FRCC recommendation, the **protection area for small redfish** located north of Browns bank (known as the 'Bowtie') was redefined in early 1998. Landings from that general area (4Xo) were very low through all of 1998 and into 2001 (less than 10% of total landings).

A number of areas have been closed to redfish fishing to avoid **bycatches** of other species, in addition to limits on percentage bycatch. Pollock as a percent of the redfish catch accounts for most of the reported bycatch in Unit 3 and has increased steadily since 1994.

The highest bycatch rates for pollock were in Crowell and Jordan basins, but generally neither industry nor management has considered the situation there to be a problem because most of this bycatch consisted of legal sized fish, which was counted towards the vessel quotas.

Observer data for 1998-2001 indicate a much higher bycatch rate for pollock and spiny dogfish (legally discarded) than do reported landings but the observer data are too limited to allow extrapolation to the fleet as a whole.

Industry Perspective

Otter trawler operators are making longer trips (5 days as opposed to 4) and are concerned over the continued concentration of fishing effort in Crowell and Jordan basins particularly around the 43°30′ line. They are also troubled by increasing bycatches of non-target species and are having difficulties avoiding catches of small redfish.

Resource Status

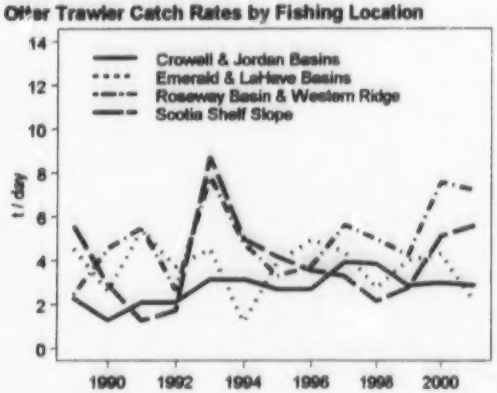
Information on the annual spatial distribution and size composition from the July DFO research vessel surveys (RV) is contained in Branton and Black (2001).

The increase in **landings** after 1992, resulting from an increase in fishing effort by otter trawlers, reflected decreased fishing opportunities for more valuable species, and not an increase in redfish abundance. The decrease in catches since 1996, resulted from a decrease in effort by these same vessels, reflecting decreased demand at the

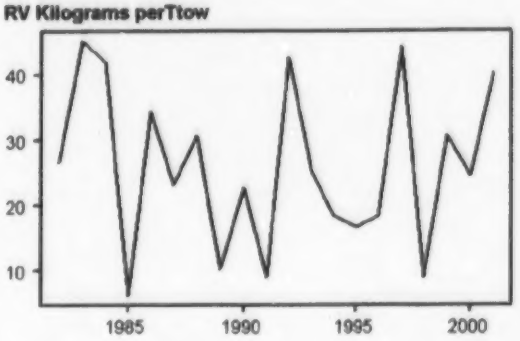
processing plants for the smaller fish and not a decrease in redfish abundance.

The **extent of area** occupied by otter trawlers directing for redfish (main species caught) has expanded since 1990 with some stabilization in the most recent years.

Fishing success of otter trawlers to the westward (Crowell and Jordan basins) has not changed much through most of the 1990s. The continued high catches from this area have mainly resulted from the sustained concentration of fishing effort there. Success for small trawlers to the eastward (Emerald and Lahave basins) has fluctuated over time as new fishing locations are found and exploited. Fishing success in the Roseway and Western Ridge for 2001 although higher than in other areas of Unit 3, were mainly the result of limited catches of small fish in that area.

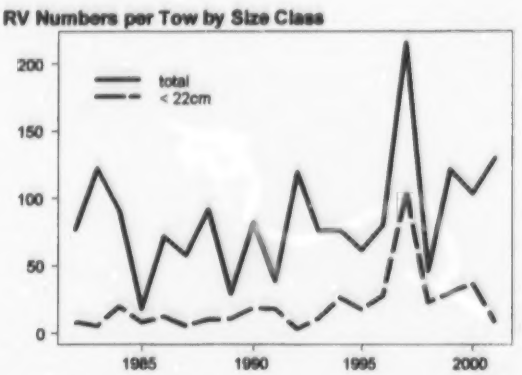


RV estimates of **population biomass** (< 200 fm) in the management unit, although highly variable between years, show no trend over time. Redfish smaller than commercial size do not contribute greatly to this biomass estimate, so survey biomass can be taken as an indicator for the size classes fished commercially. However, survey biomass underestimates the actual biomass on which the commercial fishery is based, as not all of the commercial sized fish are available to the survey gear, and some are outside the survey area (deeper than 200 fm).



The joint DFO Science/Industry (**ITQ**) survey in Division 4X provides biomass estimates similar to the research vessel survey for that area, but the estimates are less variable. The ITQ surveys indicate abundance in 2001 similar to previous years.

With regards to **recruitment**, the RV survey shows considerably more small fish (< 22 cm) in the late 1990s, particularly in the area north and east of Browns Bank, but a decline more recently.



The U.S. research vessel surveys in the Gulf of Maine, which surveys part of the Canadian fishing grounds, indicate that the biomass of redfish appears to have increased during the mid-1990s through combined

effects of growth and survival of fish from a period of relatively successful reproduction in the early 1990s (Clark 2000).

Historically, $F_{0.1}$ for redfish stocks has been estimated to be an exploitation rate of approximately 12% (DFO 2000). However it has not been possible to estimate this in absolute terms. The ratio of recent catches compared to DFO survey biomass estimates is used as a proxy which indicates that **exploitation** is low and probably does not exceed $F_{0.1}$.

Outlook

The outlook from the last full assessment report (DFO 1999) stated:

> "DFO research vessel surveys indicate stability in the population biomass within the management unit and improved recruitment particularly in and around Roseway Basin and Western Ridge. This recruitment, although promising, has not yet resulted in a detectable increase in the population biomass, but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 2000/01 being very much the same as in recent years.
>
> There is no biological or fishery basis to suggest a need for change in the management of the resource at this time."

The new information presented in this document provides no basis for changing that advice. However, evidence that the period of improved recruitment may be over, would have consequences for yield in the medium term.

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References

Branton, R. 1999. Update on the Status of Unit 3 redfish: 1999. DFO Stock Assessment Secretariat Res. Doc. 99/152.

Branton, R., and G. Black. 2001. 2001 Summer Groundfish Survey Update for Selected Scotia-Fundy Groundfish Stocks. Can. Sci. Adv. Sec. Res. Doc. 2001/096.

DFO, 2000. Status of Redfish Stocks in the Northwest Atlantic: Redfish in Units 1 and 2, and in Division 3O. DFO SSR A1-01 (2000).

Clark, S.H. (Ed.). 2000. Status of the Fishery Resources off the Northeastern United States. NOAA Technical Memorandum NMFS-NE-115.

Witch Flounder on the Scotian Shelf (Div. 4VWX)

Background

Witch flounder (Glyptocephalus cynoglossus) occur in the Northwest Atlantic from off southern Labrador to Cape Hatteras, usually at 50 - 300m in water of 2 to 6° C. but they have been recorded between 18 and 1570m and at -1 to 11° C. They occur most commonly in deep holes and channels and along the shelf slope on muddy bottom. There is no evidence that witch undertake extensive migrations but there are seasonal changes in concentration associated with spawning. The spawning period is protracted, and on the Scotian Shelf is thought to occur from May to October with a peak in July-August. The post-larval, pelagic phase is unusually long, lasting up to one year, and it is thought that the first few years of demersal life are spent in much deeper water than adults. Food consists of primarily of worms supplemented by other benthic invertebrates such as small crustaceans and bivalve molluscs. Witch is a long-lived, slow growing species; a maximum age of about 30 years and a maximum size of 78 cm (weight of about 5 kg) have been recorded.

Stock structure of witch flounder is not known and Div. 4VWX is a management unit based on administrative, rather than biological considerations. There is continuity in distribution of witch between Div. 4V and Div. 4RST and Div. 3P that suggests some affinities among these populations. Similarly, concentrations of witch in western Div. 4X are continuous with those in the rest of the Gulf of Maine.

The most recent full assessment of this stock was conducted in 1997 (SSR A3-19). Annual updates have been conducted since. More recent information from the fishery and the summer research vessel survey is presented in this update.

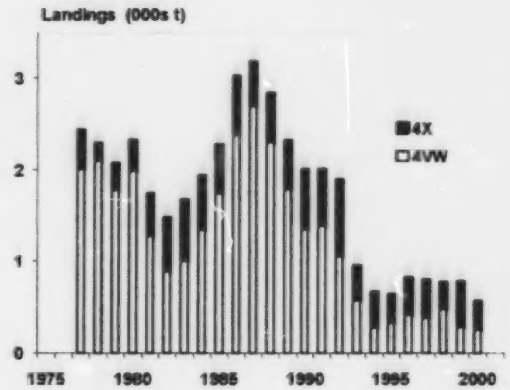
The Fishery

Landings (tonnes)

Year	1977-79 Avg	1980-89 Avg	1990-96 Avg	1997	1998	1999[1]	2000[2]	2001
Total	2264	2259	1277	798	766	775	557	

1. Fishing year, landings and TAC refer to the 15-month period from January 1, 1999 to March 31, 2000.
2. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year

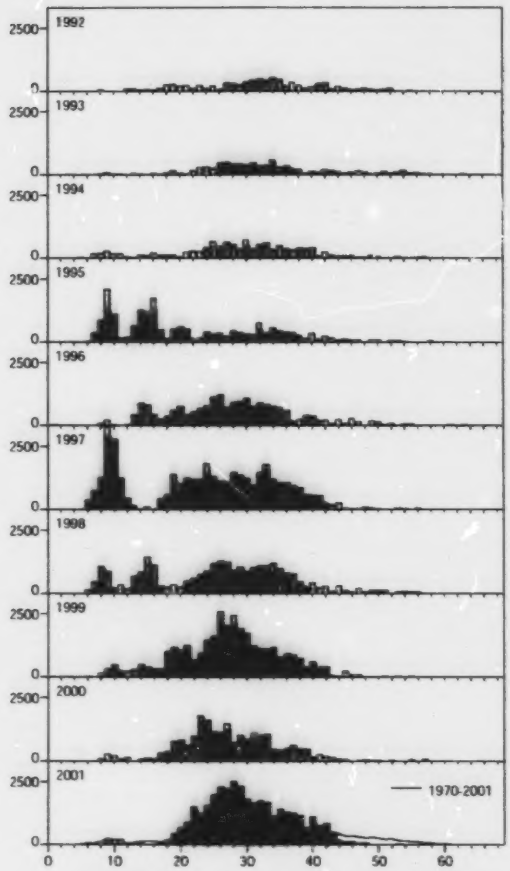
The 2001 landings are 354t for the period April 1st to October 24th. Historical information on the witch flounder fishery is contained in McRuer *et al.* (1997). Witch flounder is managed as part of the flatfish TAC for 4X and 4VW.



Resource Status

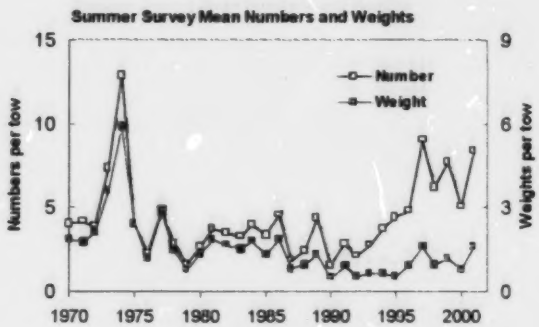
Information on the annual spatial distributions and size composition from the July research vessel surveys is contained in Branton and Black (2001).

Since 1993, there are signs of improved recruitment (<35cm), as observed in the increasing summer survey numbers per tow.



4VWX Witch Flounder combined length frequency from summer research surveys 1992 to 2001

Survey weight per tow modestly increased from a low in 1995, but is still low relative to the long-term.



Outlook

When referring to the strong recruitment seen since 1993, the outlook from the last full assessment concluded:

> "It is not known to what extent this recruitment will contribute to the populations presently being fished in Subdiv. 4Vn and in Div. 4X. In any case, witch year-classes can be expected to progressively contribute to the fishery over a substantial number of years beginning at about age 6. Any concentration of fishing on recruiting age groups at this time would be detrimental to potential future yields, as well as result in the opportunity being missed to rebuild the population of commercial-sized fish.
>
> Given the multi-species character of the flatfish TAC, there is substantial opportunity to direct increased effort towards witch flounder, which would be undesirable under present circumstances. Furthermore, the present flatfish TAC has not been limiting on catches from the species complex as a whole. Thus, the proportion of flatfish landings attributable to witch flounder should be maintained close to the status quo."

Both numbers and weight per tow increased in the 2001 research survey compared to 2000. Recruitment remains stronger than in the 1980s and early 1990s and its contribution to the population is becoming evident in the size composition.

Although the new information continues to support a positive view of recovery, the short-term outlook for the stock remains unchanged.

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References

Branton, R.,, and G. Black. 2001. 2001 summer groundfish fish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

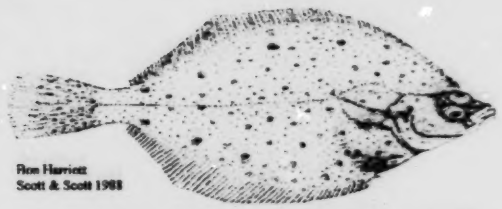
DFO, 2000. Updates on Selected Scotian Shelf Groundfish Stocks in 2000. DFO Sci. Stock Status Report. A3-35(2000).

DFO, 1999. Updates on Selected Scotian Shelf Groundfish Stocks in 1999. DFO Sci. Stock Status Report. A3-35(1999).

DFO, 1998. Updates on Selected Scotian Shelf Groundfish Stocks in 1998. DFO Sci. Stock Status Report. A3-35(1998).

DFO, 1997. Witch Flounder in Div. 4VWX. DFO Sci. Stock Status Report. A3-19(1997).

McRuer, J., R.G. Halliday, R.M. Branton, M.A. Showell, and R. Mohn. 1997. Status of witch flounder in Div. 4VWX in 1997. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/106.



Ron Harriott
Scott & Scott 1988

American Plaice, Yellowtail Flounder, and Winter Flounder on the Western Scotian Shelf (Div. 4X)

Background

Flatfish are bottom dwelling fishes primarily associated with soft substrate (mud and sand bottom). They are unique among other fish in being asymmetrical, both eyes lying on one side of the highly flattened body. Early in life, they start swimming on one side, and the eye on the underside migrates to the upper side. Flatfishes lie on the bottom on the blind side. Principal food items include crustaceans, molluscs, polychaete worms and small fishes.

Prior to 1994, yellowtail flounder (Limanda ferruginea), witch flounder (Glyptocephalus cynoglossus) and American plaice (Hippoglossoides platessoides) were managed as one stock complex (4VWX); winter flounder (Pseudopleuronectes americanus) was excluded from management considerations. In 1994, the management area was divided into an eastern (4VW) and western (4X) component, winter flounder was included, and the overall Total Allowable Catch (TAC) partitioned between the two areas based on catch history. The flounder fishery in 4X was placed under the Individual Transferable Quotas (ITQ) program in August 1994.

Management of the four species together under one TAC reflected the fact that it has been impossible to obtain reliable statistics on landings separated by species. The reported witch flounder landings are generally considered to be reliable, due to the higher price paid for this species. But the unreliability of the catch data for the other three species, coupled with the reports from the fishing industry of serious mis-reporting of other species as flatfish prior to 1991 eliminates the value of that information in determining resource exploitation. Initiation of ITQ logs and dockside monitoring of landings has had limited success in separating catch to individual species because landings were not separated at weighout or were misidentified by the weighmaster. It was decided to assess witch flounder separately from the other three species in 1997, but it is still managed as part of the general flounder TAC.

The most recent full assessment of this stock was conducted in 1997 (SSR A3-21 (1997)). Annual updates were conducted in 1999 (SSR A3-35 (1999)) and 2000 (SSR A3-35 (2000)). More recent information from the fishery and the summer research vessel survey is presented in this update.

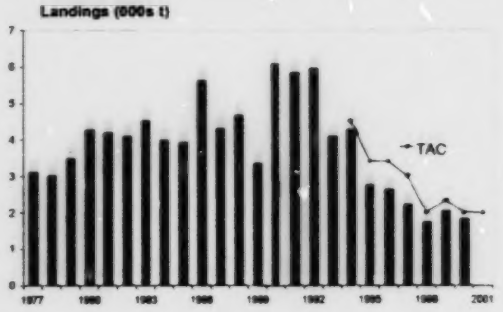
The Fishery

Landings (000s t)

Year	1977-79 Avg	1980-89 Avg	1990-96 Avg	1997	1998	1999[2]	2000[3]	2001
TAC[1]				3.0	2.0	2.3	2.0	2.0
Total	3.2	4.3	4.5	2.2	1.7	2.0	1.8	

1. The TAC and landings include witch flounder and unidentified flatfish.
2. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
3. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

To accommodate transition from a calendar fishing year to one running from April to March, a 15 month fishing year occurred in 1999/2000. As a result, the landings for the 1999/2000 fishing year include the 15 month period from January 1999 to March 2000. **Total flatfish landings** in the 2000 fishing year were 1882t. Landings of flatfish in 4X+5 for the 2001 fishing year to October 24, 2001, are 1305t (including witch flounder, but excluding 5Z yellowtail flounder).



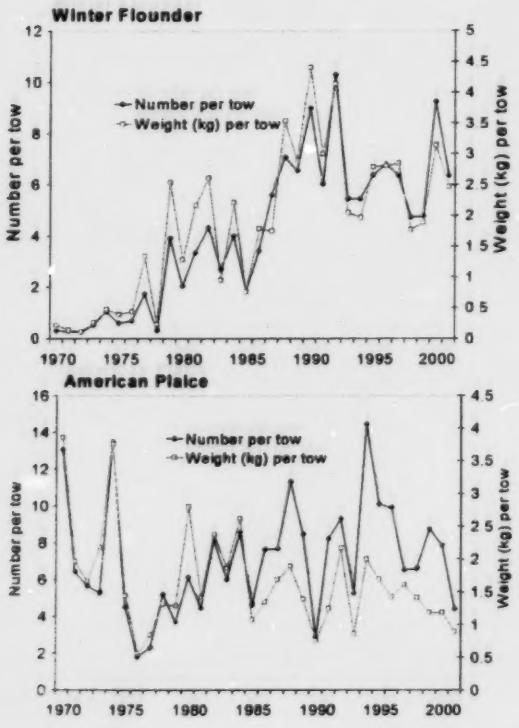
Historical information on winter flounder, yellowtail flounder and American plaice is contained in Stobo *et al.* (1997). The biggest problem for managing flatfish stocks has been inability to segregate the fisheries by species, and consequently overall quotas were applied to combined fisheries. In 1999, the Fishing Log database was used to substitute species identifications where

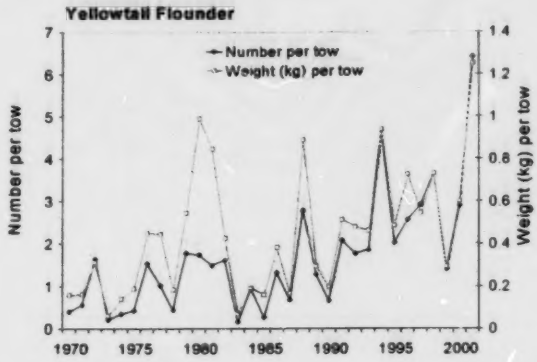
unspecified flounder was entered in the Commercial Landings database (Fowler and Stobo, 1999). These revised landings would indicate a much larger, but declining, fishery for American plaice in 4X/5 than previously thought.

Resource Status

Information on the annual spatial distributions and size composition from the July research vessel survey is contained in Branton and Black (2001).

Summer **research vessel (RV) survey** information indicates that the abundance of winter flounder has varied considerably in recent years, but is currently well above average. A large pulse of young American plaice in 1999 was not sustained in the population, abundance dropping sharply to a very low level in 2001. Yellowtail flounder abundance rose dramatically since 1999 to set a record high in 2001.





Outlook

In the past, industry has expressed concern over the depleted state of these resources. Current information indicates a very mixed set of stock status scenarios - a worsening situation for American plaice, an improving situation for yellowtail flounder, and relative stability in stock status of winter flounder.

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References

Branton, R., and G. Black. 2001. 2001 summer groundfish fish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

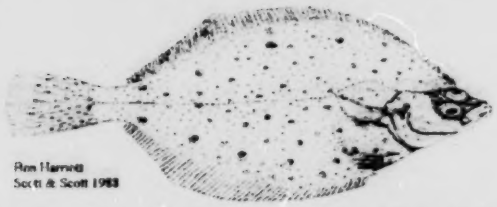
DFO, 2000. Updates on selected Scotian Shelf groundfish stocks in 2000. Stock Status Report A3-35(2000).

DFO, 1999. Updates on selected Scotian Shelf groundfish stocks in 1999. Stock Status Report A3-35(1999).

DFO, 1997. Southwest Nova Winter Flounder, American Plaice and Yellowtail Flounder Stock Status Report A3-21(1997).

Fowler, G.M., and W.T. Stobo. 1999. Reconciliation of processed catch statistics with log data for 1992-97 flatfish in 4VWX/5Y. DFO Canadian Stock Assessment Secretariat Res. Doc. 99/149.

Stobo, W.T., G.M. Fowler, and S.J. Smith. 1997. Status of 4X winter flounder, yellowtail flounder, and American plaice. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/105.



American Plaice and Yellowtail Flounder on the Eastern Scotian Shelf (Div. 4VW)

Background

Flatfish are bottom dwelling fishes primarily associated with soft substrate (mud and sand bottom). They are unique among other fish in being asymmetrical, both eyes lying on one side of the highly flattened body. Early in life, they start swimming on one side, and the eye on the underside migrates to the upper side. Flatfishes lie on the bottom on the blind side. Principal food items include crustaceans, molluscs, polychaete worms and small fishes.

Prior to 1994, yellowtail flounder (Limanda ferruginea), witch flounder (Glyptocephalus cynoglossus) and American plaice (Hippoglossoides platessoides) were managed as one stock complex (4VWX); winter flounder (Pseudopleuronectes americanus) was excluded from management considerations. In 1994, the management area was divided into an eastern (4VW) and western (4X) component, winter flounder was included, and the overall Total Allowable Catch (TAC) partitioned between the two areas based on catch history. The flounder fishery in 4X was placed under the Individual Transferable Quotas (ITQ) program in August 1994.

Management of the four species together under one TAC reflected the fact that it has been impossible to obtain reliable statistics on landings separated by species. The reported witch flounder landings are generally considered to be reliable, due to the higher price paid for this species. But the unreliability of the catch data for the other three species, coupled with the reports from the fishing industry of serious mis-reporting of other species as flatfish prior to 1991 eliminates the value of that information in determining resource exploitation. Initiation of ITQ logs and dockside monitoring of landings has had limited success in separating catch to individual species because landings were not separated at weighout or were misidentified by the weighmaster. It was decided to assess witch flounder separately from the other three species in 1997, but it is still managed as part of the general flounder TAC.

The most recent full assessment of this stock was conducted in 2000 (SSR A3-34 (2000)). More recent information from the fishery and the summer research vessel survey is presented in this update.

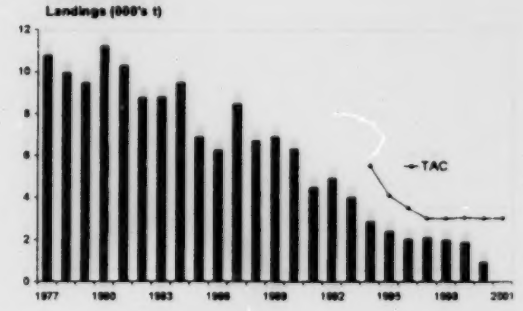
The Fishery

Landings (000s t)

Year	1977-1979 Avg	1980-1989 Avg	1990-1996 Avg	1997	1998	1999[2]	2000[3]	2001
TAC[1]				3.0	3.0	3.0	3.0	3.0
Total	10.0	8.4	3.8	2.1	2.0	2.1	0.9	

1. The TAC and landings include all flatfish species except Atlantic halibut.
2. Fishing year, landings and TAC refer to the 15-month period from January 1 1999 to March 31, 2000.
3. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

To accommodate transition from a calendar fishing year to one running from April to March, a 15 month fishing year occurred in 1999/2000. As a result, the landings for the 1999/2000 fishing year include the 15 month period from January 1999 to March 2000. **Total flatfish landings** in 2000/2001 were 909t. The 2001 fishing year landings of flatfish in 4VW to October 24, 2001, are 588t.



Historical information on yellowtail flounder and American plaice is contained in Fowler and Stobo (2000). American plaice are fished primarily in 4Vs (Banquereau) and 4Vn (Sydney Bight), with most of the 4Vn catches since 1995 made in the spring and fall. The yellowtail flounder fishery was most active on Banquereau and Sable Island Bank (4W) through the mid-1980s. From about 1987 the yellowtail fishery was concentrated on the southeast corner of Banquereau until the fishery virtually disappeared in 1996.

There has not been a significant yellowtail fishery since that time.

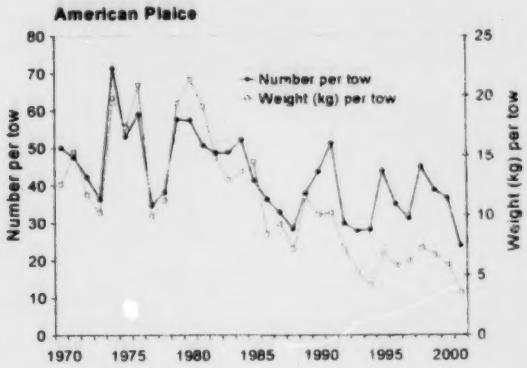
The biggest problem for managing flatfish stocks has been inability to segregate the fisheries by species, and consequently overall quotas have been applied to combined fisheries. In 1999, the Fishing Log database was used to substitute species identifications where unspecified flounder was entered in the Commercial Landings database (Fowler and Stobo, 1999). These revised landings disspelled earlier impressions of dramatic growth of the fishery for American plaice in 4VW.

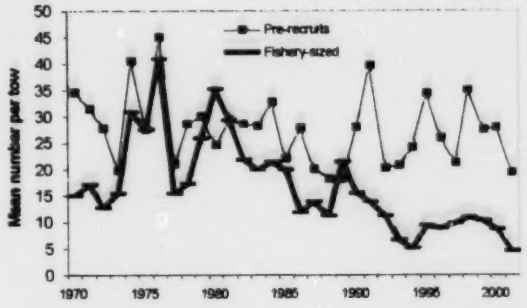
Resource Status

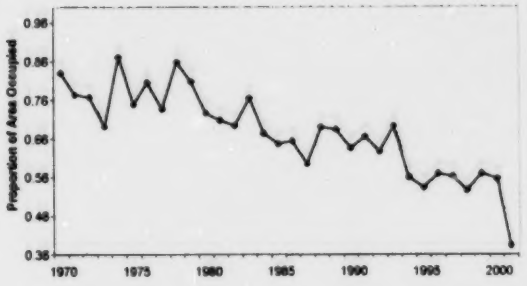
Information on the annual spatial distributions and size composition from the July research vessel survey is contained in Branton and Black (2001).

American Plaice

Summer **research vessel (RV) survey** information indicates a declining trend in abundance of American plaice from 1980 to 1994. This was followed by a period of stability at very low abundance until 2001, which is a record low. Most of the decline in abundance of American plaice has been associated with fishery-sized components of the population, and the decline is reflected by reduction in the area occupied by this stock within 4VW. The area occupied for fishery-sized (31cm +) plaice dropped sharply to a record low in 2001. Abundance of pre-recruit sizes (under 31 cm) show no clear trends over time.

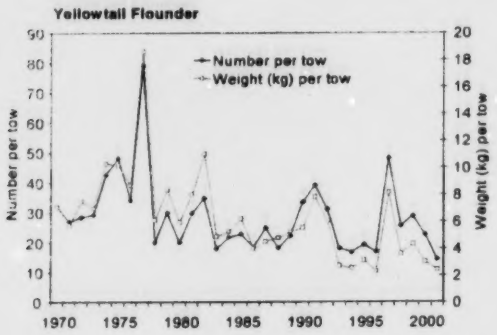


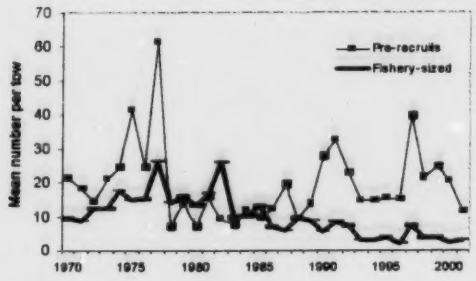


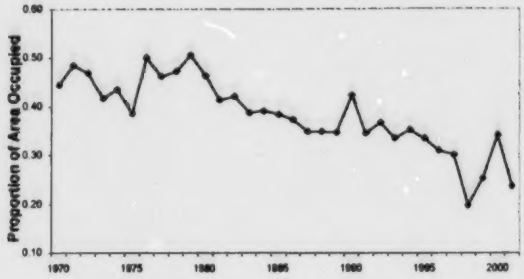


Yellowtail Flounder

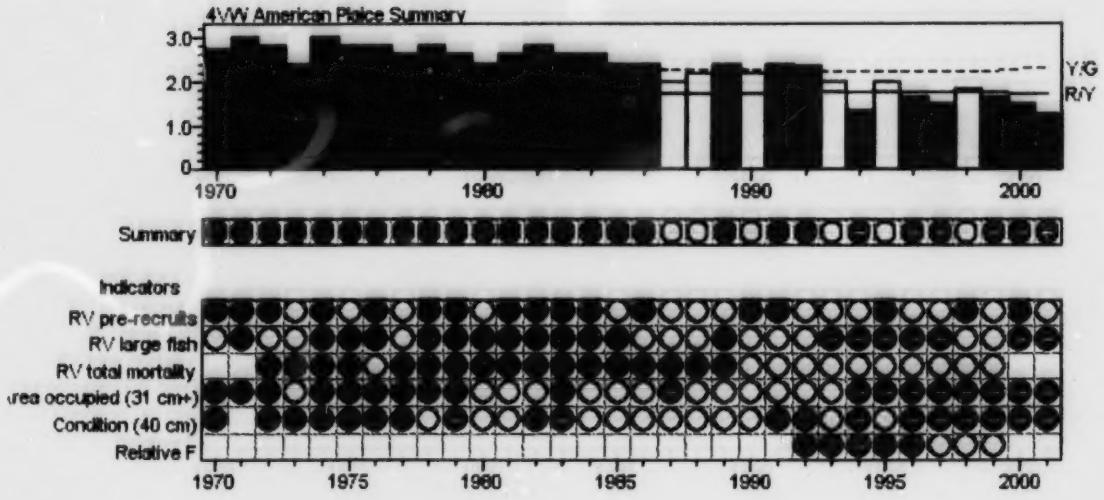
Since the 1970s, yellowtail flounder abundance has been declining. The estimate for 2001 is a record low. Most of the decline in abundance of yellowtail flounder has been associated with fishery-sized components of the population, and the decline is reflected by reduction in the area occupied by this stock within 4VW. The area occupied for fishery-sized (31cm +) yellowtail in 2001 is the second lowest on record. Abundance of pre-recruit sizes (under 31 cm) are highly variable over time, and have declined over the last couple of years.

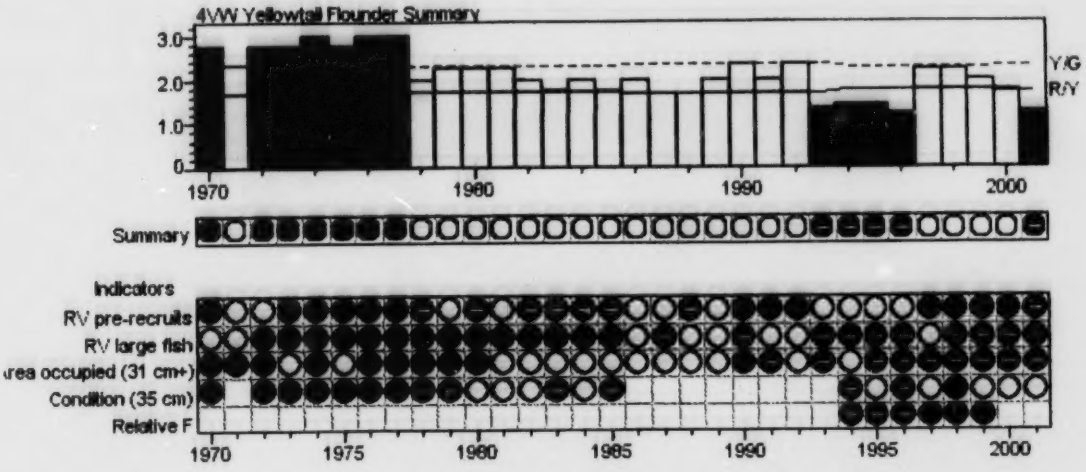






The **Traffic Light** tables that follow summarize the indicators of stock status applied to American plaice and yellowtail flounder in the last assessment. Each table shows the annual values of each indicator as one of three lights depending on whether they are among the highest values observed for that indicator, among the lowest or in between. For indicators such as stock biomass and recruitment, high values are good and have a green light and low values are bad and have a red light. However, for indicators such as mortality, high values are bad and are assigned a red light●, whereas low values are good and receive a green light●. Intermediate values are yellow○.





Outlook

Continuing indications of stock decline are evident for both the American plaice and yellowtail flounder resources. Fishing mortality should be reduced until there is an increase in the abundance of fishery-sized components of the populations.

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References

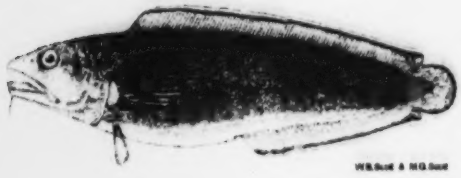
Branton, R., and G. Black. 2001. 2001 summer groundfish fish survey update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 2000. American Plaice and Yellowtail Flounder on the Eastern Scotian Shelf (Div. 4VW). DFO Sci. Stock Status Report A3-34 (2000).

Fowler, G.M., and W.T. Stobo. 2000. Status of 4VW American plaice and yellowtail flounder. DFO Canadian Stock Assessment Secretariat Res. Doc. 2000/144.

Fowler, G.M., and W.T. Stobo. 1999. Reconciliation of processed catch statistics with log data for 1992-97 flatfish in 4VWX/5Y. DFO Canadian Stock Assessment Secretariat Res. Doc. 99/149.

Stobo, W.T., G.M. Fowler, and S.J. Smith. 1997. Status of 4X winter flounder, yellowtail flounder, and American plaice. DFO Canadian Stock Assessment Secretariat Res. Doc. 97/105.



Cusk on the Scotian Shelf (Div. 4VWX)

Background

Cusk (Brosme brosme) is a solitary, slow swimming species, found primarily on the southwestern Scotian Shelf and Slope and in the Fundian Channel, that seldom moves from bank to bank. Based on July research surveys, cusk occur in temperatures ranging from 3 to 11°C with most being caught in the 6-10° C range, at depths of 75-150 m. They also prefer a rocky bottom, or gravel and occasional mud but seldom sand.

Spawning on the Scotian Shelf is believed to occur from May to August, peaking in June. The buoyant eggs are 1.3-1.5 mm in diameter with a pinkish oil globule. The pelagic larvae are about 4 mm when hatched, migrating to the bottom when they have grown to approximately 50 mm in length. Males appear to grow slightly faster than females, (reaching 45 cm at five years of age) and appear to mature more rapidly.

The diet of cusk on the Scotian Shelf is unknown, as their stomachs invert when they are brought to the surface. In European waters, cusk feed primarily on crabs and molluscs, along with the occasional starfish. Observations on this side of the Atlantic reveal cusk feeding on crabs and the occasional mollusc off the coast of Maine. The only known predation record was by a hooded seal off Greenland. There is no record of cusk occurring in seal stomachs on the Scotian Shelf.

The most recent full assessment of this stock was conducted in 1998 (DFO, 1998). Annual updates have been conducted since then. More recent information from the fishery and the summer research vessel surveys is presented in this update.

The Fishery

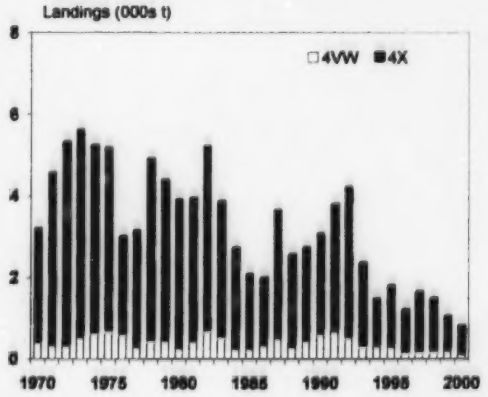
Landings (tonnes)

Year	1970-79 Avg	1980-89 Avg	1990-96 Avg	1997	1998	1999[1]	2000[2]	2001
4VW	468	395	408	174	186	179	109	-
4X	4001	2882	2165	1475	1304	879	717	-
TOTAL	4469	3277	2573	1649	1490	1058	826	-

1. Fishing year and landings refer to the 15-month period from January 1 1999 to March 31, 2000.
2. Commencing in 2000, fishing year and landings refers to the period April 1 of the current year to March 31 of the following year.

Cusk was placed under bycatch limitations for the first time in 1999. A cap of 1000t was placed on the combined landings of all fleets. The 2001 fishing year landings, April 1 to October 24, are 999t. The total landings for the 2001 fishing year will exceed the 1000t cap.

Cusk are primarily caught by longline (95%), with over 80% of the landings coming from 4X. In 4X, landings have varied from a maximum of 5,130t in 1973 to a low of 717t in 2000. The general pattern of landings is one of a gradual decrease from the early 1970s to the present. Landings in Division 4W have rarely exceeded 500t, while landings in Division 4V have been negligible.



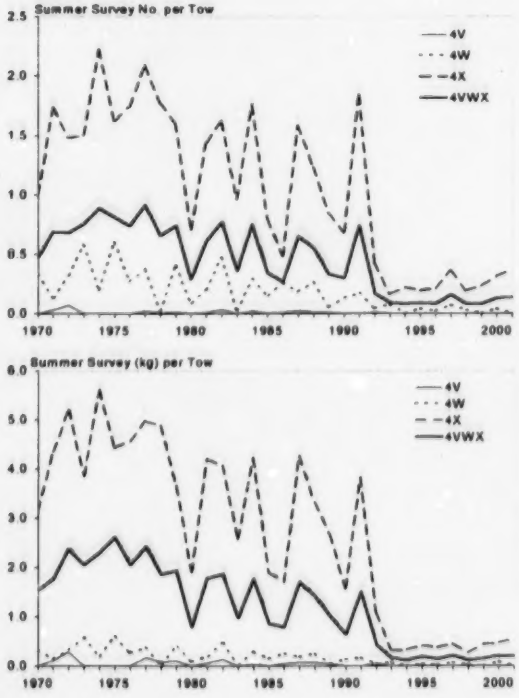
The most common (modal) size in commercial length frequency samples of cusk from the early 1970s and early 1980s was between 64 to 67cm, similar to modal size in

the research vessel survey over the same period. These are consistent with modal sizes reported by Oldham (1972) from LaHave Bank in the mid 1960s. The size composition from commercial samples since 1988 has shown no consistent pattern with modes ranging from 52-61 cm.

Resource Status

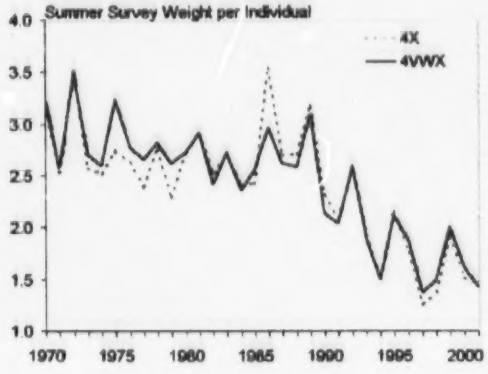
Information on the annual spatial distribution and size composition from the July research vessel surveys is contained in Branton and Black (2001).

Cusk **biomass** in both 4W and 4X (the centre of the historic distribution) has shown a gradual decline since the start of groundfish **research vessel (RV)** surveys in 1970. Research survey indices show a gradual decrease in both numbers per tow and weight per tow since the late 1970s with an apparent collapse in 1992.

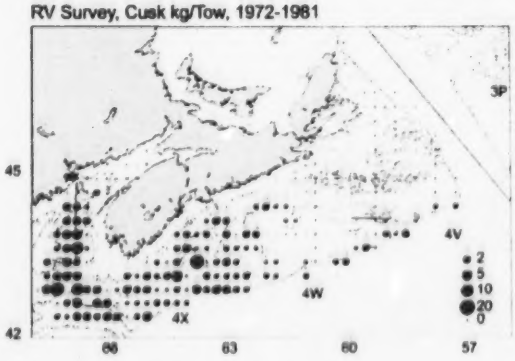


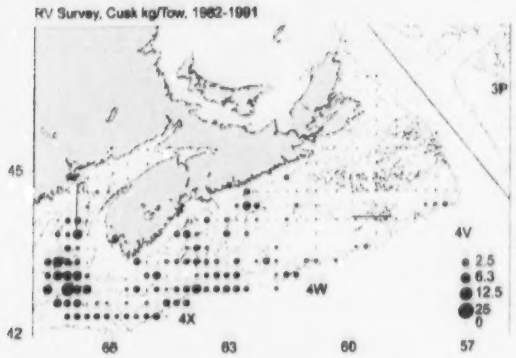
Summer research vessel surveys also show a decrease in abundance of cusk greater than 50 cm.

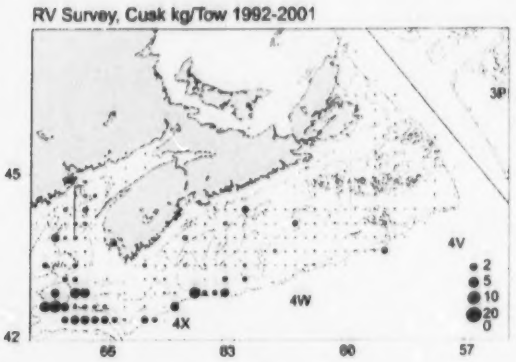
Mean weight per individual from the research vessel survey has declined since 1989.



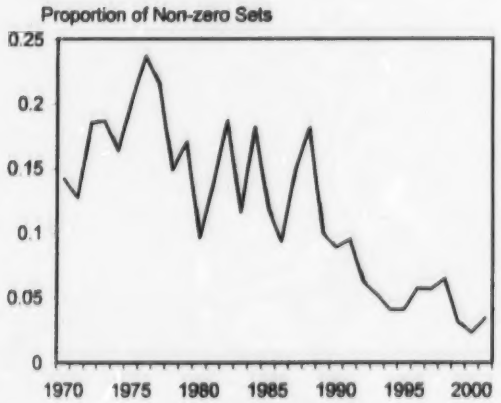
A comparison of the **geographic distribution** from summer research vessel surveys indicates a significant contraction of cusk distribution in recent years. Since 1991, few cusk are distributed along the seaward edges of Western/Emerald/Sable Island and Banquereau banks.







The proportion of annual survey sets where the species occurs (non-zero sets) is a measure of the area occupied within its historical geographic range. For cusk, this index has shown a steady decline since the late 1980s, indicating concentration of the resource.



Outlook

The outlook from the last full assessment (DFO, 1998) for this stock included the following:

> "Given the apparent collapse of the cusk population since 1992, immediate and substantial restrictions on cusk landings are required. Elimination of the directed fishery is necessary. Rebuilding of the stock will probably require a combination of both traditional and innovative measures. A restrictive bycatch would aid in rebuilding efforts, but may be difficult to implement without discarding."

Despite the recent introduction of catch controls, this is a stock which shows no signs of improvement. It is likely that the 1000t cap placed on this stock is not providing adequate restrictions on catches to allow for the stock to rebuild and more restrictive measures may be required.

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References

Branton R., and G. Black. 2001. 2001 summer groundfish survey update for selected Scotia-Fundy groundfish

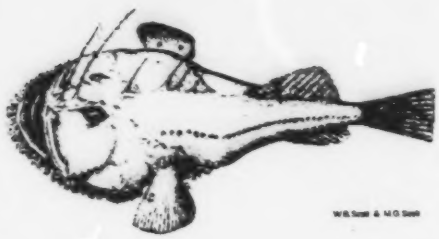
stocks. Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 1999. Updates on Selected Scotian Shelf Groundfish Stocks in 1999. DFO Sci Stock Status Report A3-35(1999).

DFO, 1998. Cusk on the Scotian Shelf. DFO Sci. Stock Status Report A3-14(1998).

Oldham, W.S. 1972. Biology of Scotian Shelf cusk, *Brosme brosme*. ICNAF Res. Bull. 9:85-98.

Scott, W.B., and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.



Monkfish on the Scotian Shelf and Northeast Georges Bank (4VWX and 5Zc)

Background

Monkfish, Lophius americanus, also called goosefish or angler, ranges from the Grand Banks and Northern Gulf of St. Lawrence south to Cape Hatteras, North Carolina. Individuals have been collected from inshore areas to depths greater than 800m, although highest concentrations occur between 70-100m and in deeper waters of about 190m. They have been taken at temperatures from 0-24°C, but in Canadian waters, appear most abundant between 3-9°C.

The stock structure of monkfish is unknown, but USA survey distributions suggest northern and southern components with the shallow waters of central Georges as a boundary zone. Canadian survey distributions do not suggest a discontinuity between the 4X, 4W and 5Zc components of this stock. The degree of mixing in both USA and Canadian waters is unknown and large scale migrations have not been reported. Spawning appears to take place in Canadian waters during the summer months, thus suggesting some degree of independence between the various components.

The monkfish has been described as mostly mouth with a tail attached, and reports of monkfish eating prey almost as big as themselves are common. Growth appears to be fairly rapid and similar for both sexes up to age 4, (47-48cm). After this, females grow a bit more rapidly and seem to live somewhat longer, up to 12 years, reaching a size of over 100cm while the males have not been found older than age 9, at approximately 90cm.

Sexual maturity occurs between ages 3 and 4 and spawning may take place from spring through to autumn depending on latitude. Females lay a nonadhesive, buoyant mucoid veil that can be as large as 12m long and 1.5m wide. Incubation lasts from 7-22 days, after which the larvae spend several months in a pelagic phase, before settling to the bottom at a size of about 8 cm.

The most recent full assessment of this stock was conducted in fall 2000 (SSR A3-30 (2000)). More recent information from the fishery and the summer research vessel survey is presented in this update.

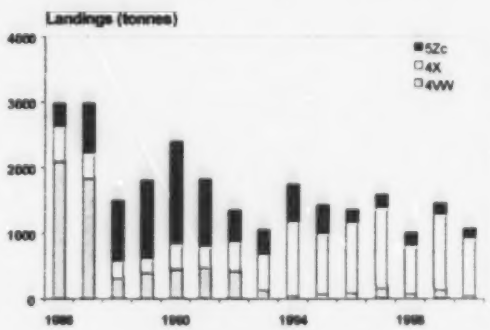
The Fishery

Landings (tonnes)

Year	1970-79 Avg	1980-89 Avg	1990-96 Avg	1997	1998	1999[2]	2000[3]	2001
Allocation	-	-	300[1]	300[1]	300[1]	300[1]	-	-
4VW	6005	557	236	144	68	118	38	
4X	565	287	706	1249	748	1170	865	
5Zc	-	793[4]	648	189	190	151	177	
Total	6570	1637	1590	1582	1006	1432	1080	

1 Experimental directed monkfish fishery (beginning in 1995 at 200 t).
2 Allocation and landings refer to the 15 month period from January 1, 1999, to March 31, 2000.
3 Commencing in 2000, fishing year and landings refer to the period April 1 of the current year to March 31 of the following year.
4 Average is from 1986 to 1989 as no 5Zc designation prior to 1986.

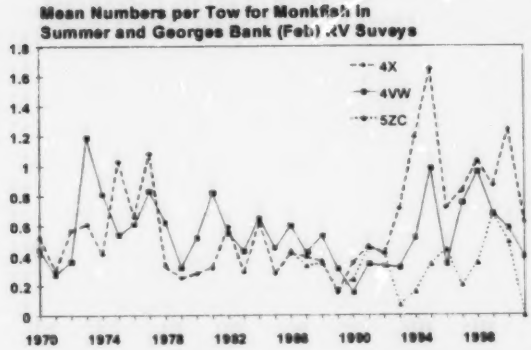
Detailed historical information on the monkfish fishery is contained in Beanlands and Annand (1996). Landings data from 1999 represent additional information since the last SSR. (DFO, 2000). The 2001 landings form April 1st to Oct. 24 are 27, 502, 114 tonnes respectively for 4VW, 4X and 5Zc.

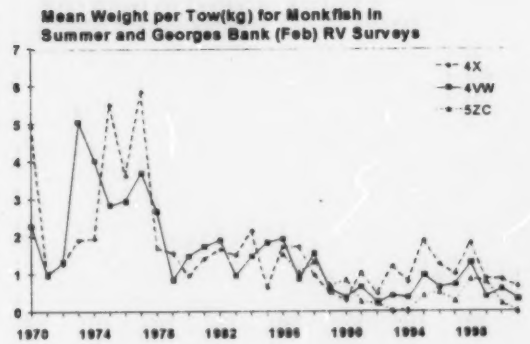


Resource Status

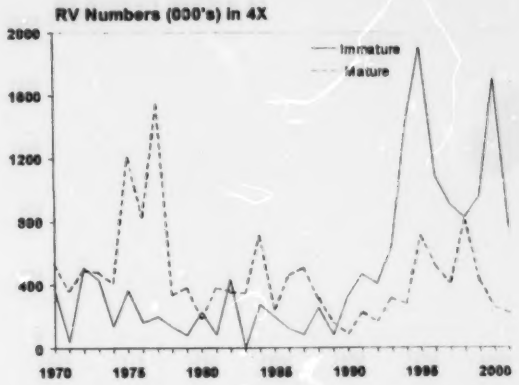
Information on the annual spatial distributions and size composition from the July research vessel surveys is contained in Branton and Black (2001).

The DFO summer research vessel (RV) survey results for 2001 in 4X show an increase in abundance during the early to mid 1990s, with recent variation around a high level. Abundance in 4VW, after a rise during the mid 1990s, has been recently falling. Abundance in 5Zc showed an increase from 1993 but subsequently declined to the lowest value in the series. Mean weight per tow for all three areas has remained at a low level.


Mean Numbers per Tow for Monkfish in Summer and Georges Bank (Feb) RV Surveys
4X
4VW
5ZC
1970 1974 1978 1982 1986 1990 1994 1998

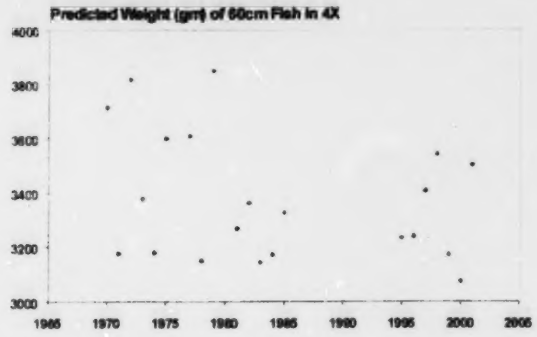

Mean Weight per Tow(kg) for Monkfish in Summer and Georges Bank (Feb) RV Surveys
4X
4VW
5ZC
1970 1974 1978 1982 1986 1990 1994 1998

Survey numbers were separated into immature and mature sizes. Since about 1993, immature abundance has increased and while recent RV estimates are variable, they remain higher than the pre 1993 values. Numbers of mature fish in 4X continued to decline from mid 1990s levels. The numbers of immature fish have also declined in 4VW while mature numbers have increased slightly.

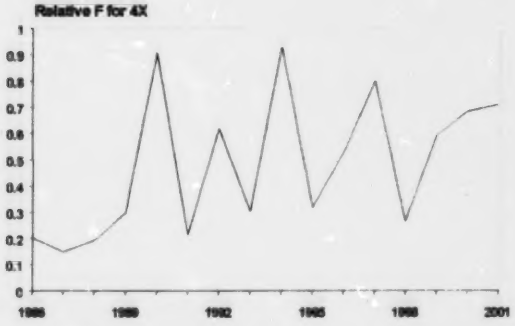


The proportion of the RV survey sets where monkfish occurs is a measure of **area occupied.** The number of sets in 2001 where monkfish occurred is down from the 2000 value in 4X and only slightly higher in 4VW. However, area occupied has remained high since 1993, indicating that the resource is currently more widely distributed.

Condition, the predicted weight of a fish at a given length from the summer RV survey is used as an indicator of the health of the fish. The predicted weight of a 60 cm (mature) monkfish in 2001 RV survey was 3.5 kg, slightly above the long term mean.



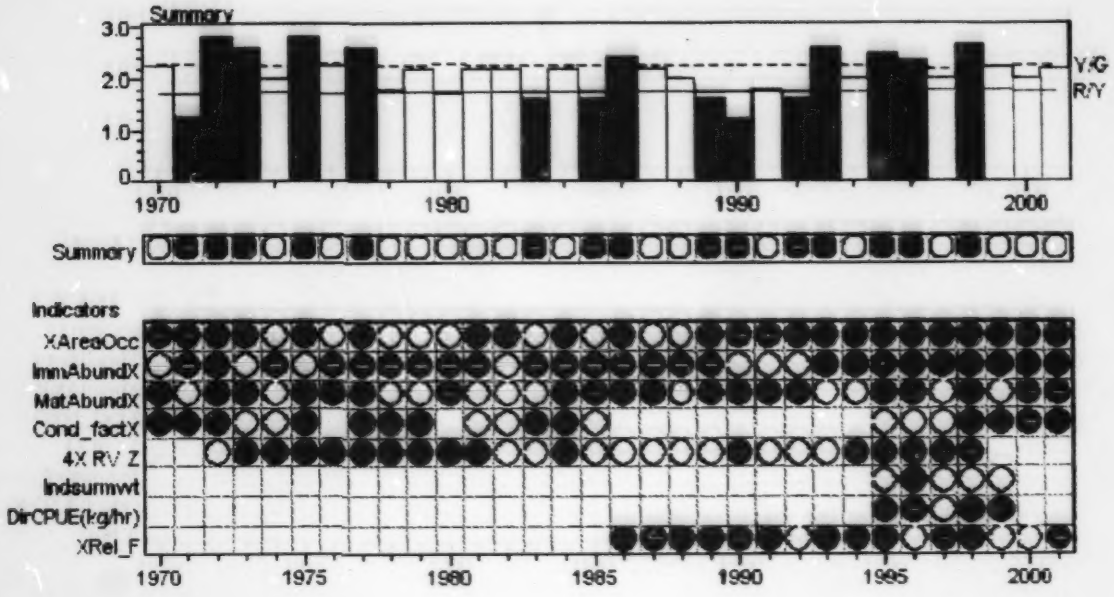
Relative Fishing Mortality (F) (catch divided by the RV survey biomass) for 4X has been variable but shows an increasing trend since 1998.



The **Traffic Light** table that follows summarizes the indicators of stock status shown above. The current stock area includes all of 4VWX and 5Zc but in the last 5 years, the exploratory fishery has been conducted almost entirely in 4X and most of the balance of the landings also come from that area. The relationship between 4X and the balance of the stock area is unknown. Because of the current fishery distribution, 4X will be given specific focus particularly with respect to the traffic light approach.

This table shows the annual values of each indicator as one of three lights depending on whether they are among the highest values observed for that indicator, among the lowest or in between. For indicators such as stock biomass and recruitment, high values are good and have a green light● and low values are bad and have a red light●. However, for indicators such as mortality, high values are bad and are assigned a red light whereas low values are good and receive a green light. Intermediate values are yellow○.

The results for the indicators combined are shown in the summary line above the array of individual indicators. If most indicators in a particular year are red then the summary light for that year will be red, if most are green the summary light will be green, and so on. The actual summary scores from the range of indicators in the table are shown in the bar chart above the table. The height of the bar determines the colour for the corresponding year and the horizontal lines on the bar chart indicate the boundaries between the colours (red-yellow and yellow-green).



Outlook

The outlook from the last Stock Status Report (DFO, 2000) for this stock, based on assessment of the stock (Beanlands et al., 2000) included the following:

> "The summary indicator for monkfish in 4X has fluctuated between green and yellow zones in recent years and is yellow in 2000. The population appears to have gone through a period of low productivity and abundance in the late 1980s to early 1990s and the factors causing this may still be affecting the present population. There are, however, signs of improved recruitment that is beginning to have a positive influence on the adult stock size. A continuation of the recent cautious approach to harvesting is appropriate until productivity trends and the effects of harvesting can be more accurately defined.
>
> Available indicators for monkfish in 4VW show very similar trends to those for 4X, although fishery removals have been much lower. This suggests that a cautious approach to exploitation should continue in the 4VW area. It also suggests that many of the changes observed in both areas may have been driven by changes in environmental conditions."

The new information available for 4VWX since then does not suggest that the above outlook need be revised. However, the indicator trends for 5Zc are cause for concern.

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References

Beanlands, D., R. Branton, and R. Mohn. 2000. Status of monkfish in 4VWX5Zc. DFO. Canadian Stock Assessment Secretariat Res. Doc. 2000/143.

Beanlands, D., and C. Annand. 1996. Status of monkfish in 4VWX5Zc. DFO Atl. Fish. Res. Doc. 96/ 104.

Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildlife Ser. Bull. 74, Vol 53: 577p.

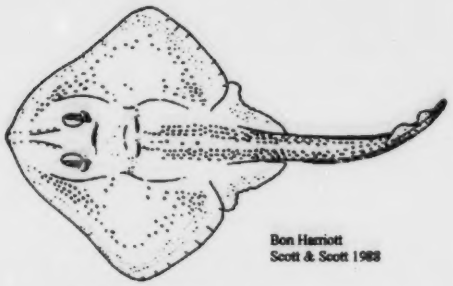
Branton, R., and G. Black. 2001. 2001 Summer Groundfish Survey Update for selected Scotia-Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 1998. Updates on Selected Scotian Shelf Groundfish Stocks in 1998. DFO Sci. Stock Status Report A3-35(1998).

DFO, 1999. Updates on Selected Scotian Shelf Groundfish Stocks in 1999. DFO Sci. Stock Status Report A3-35(1999).

DFO, 2000. Monkfish on the Scotian Shelf and Northeast Georges Bank (4VWX and 5Zc). DFO Sci. Stock Status Report A3-30(2000)

Scott, W.B., and M.G. Scott. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731p.



Winter Skate on the Eastern Scotian Shelf (4VsW)

Background

Most elasmobranch fisheries have followed a general pattern of high initial exploitation followed by a rapid collapse. The intention has been that the 'developing' skate fishery on the eastern Scotian Shelf not follow this course. Our knowledge of skate on the Scotian Shelf is limited, however recent research is increasing our information base.

Winter skate (Raja ocelatta) occur in the southern waters of Georges Bank, inner Bay of Fundy and are near their northern limit of distribution on the offshore banks of the eastern Scotian Shelf. This latter area is unique because it is the only region where thorny skate overlaps with winter skate, the former being more abundant in northern waters. Winter skate are the primary focus of the commercial fishery and constitute greater than 90% of the catch. Thorny skate occur as a bycatch in this fishery and only the largest individuals are retained.

Like other elasmobranches, skates are slow growing, produce very few young each year and thus are slow to increase in population numbers. Length at 50% maturity for female winter skate occurs around 75cm. Preliminary ageing of winter skate suggests that the length at 50% maturity coincides with individuals, which are 7-8 years old. Historical information shows that skates consume considerable quantities of sand lance. Skate predators have yet to be identified.

The most recent full assessment of this stock was conducted in fall 2000 (SSR A3-29(2000)). More recent information from the fishery, the research vessel surveys and industry surveys is presented in this update.

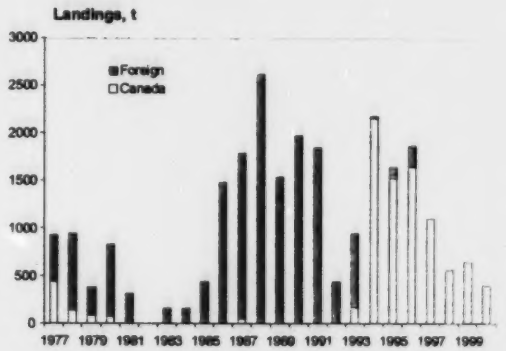
The Fishery

Landings (000s t)

Year	1970 -79 Avg	1980-89 Avg	1990-96 Avg	1997	1998	1999[6]	2000[6]	2001
TAC[1]			1733	1200	1200	600	600	400
Canada[2]	153	19	789	1093	563	648	401	
Est. Disc.[3]				68	51	65	36	
Foreign[4]	6734	913	759					
TOTAL	6887	932	1548	1161	614	713	437	

1. For 'developing' fishery only (all skate species). The TAC for 1990-1996 is the average TAC for 1994-1996
2. Reported landings of all skate species by Canadian vessels.
3. Estimated discards of winter skate based on bycatch from Canadian groundfish directed fisheries. It is not calculated prior to 1997.
4. Reported bycatch of winter skate by foreign vessels.
6. Fishing year, landings and TAC refer to the 15 month period from January 1, 1999 to March 31, 2000.
6. Commencing in 2000, fishing year, landings and TAC refer to the period April 1 of the current year to March 31 of the following year.

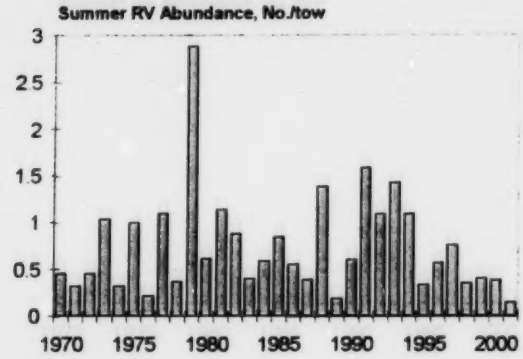
Landings data from 2000 represent additional information since the last SSR (DFO, 2000). Reported catches (to October 24, 2001) were 222t in the Canadian directed fishery and 25t estimated from discards in other Canadian fisheries. Detailed historical information on the skate fishery is contained in Simon and Frank (2000).



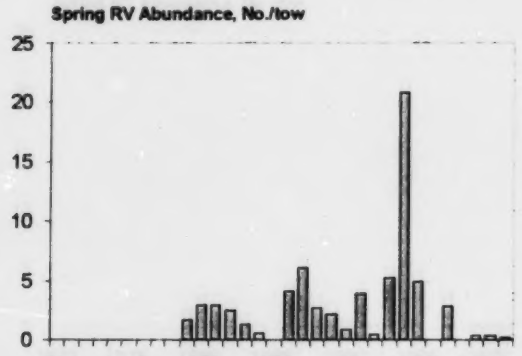
Resource Status

Information on the annual spatial distributions and size composition from the July research vessel surveys is contained in Branton and Black (2001).

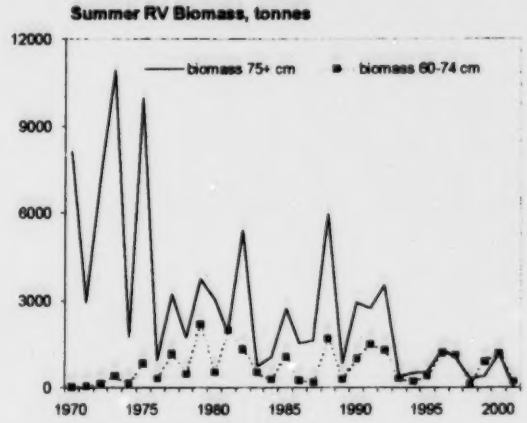
The **abundance** estimate from the summer research vessel (RV) survey in Div. 4VsW indicates no recent trend, though the 1995-2001 values have been below average. The 2001 estimate is the lowest observed in the series.



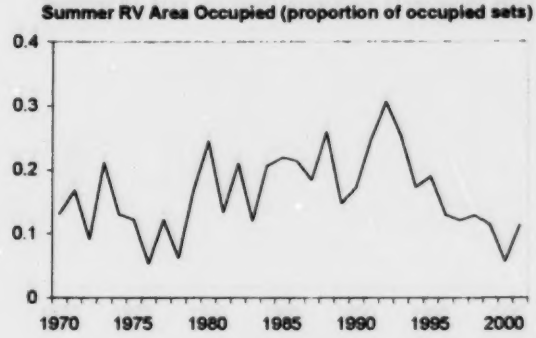
Abundance from the spring RV survey was variable with no patterns evident. The 1994 estimate was primarily due to a single tow of 1500kg. The 1999 to 2001 values were the lowest in the series.



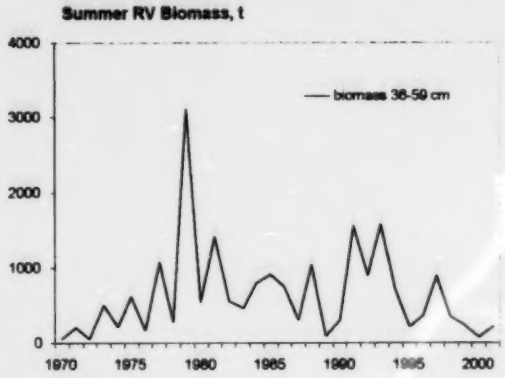
Annual estimates of fishable (60+cm) **biomass** were made from the summer RV survey for 60-74cm (immature) and 75+cm (mature) fish. In 2001, the immature fishable biomass was extremely low, while no fish greater than 74 cm (mature fishable biomass) were captured by the survey.



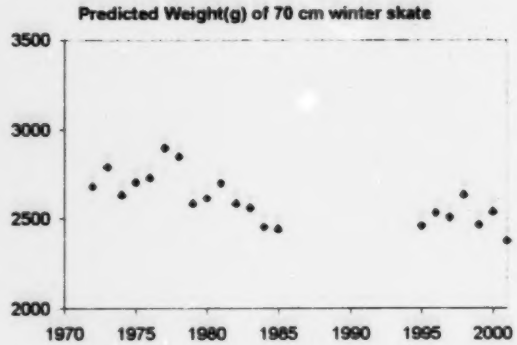
The **area occupied** (as indicated by proportion of RV sets in which winter skate occur) in Div. 4VsW in the summer RV survey was examined. The 2001 estimate has recovered from the 2000 value, which was near the lowest in the series, but is still below the long-term mean.



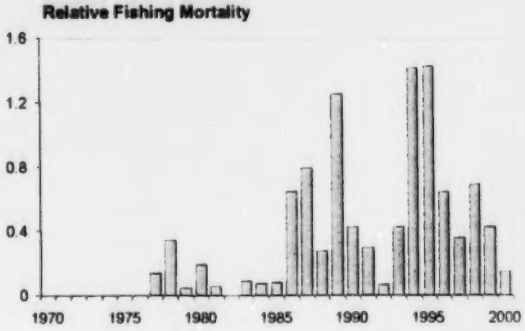
Recruitment into the fishery was approximated by the biomass of 36-59 cm fish from the summer RV. This index appears to be variable, with some indication of increased recruitment between 1991-1994, although recent values have been low.



Condition, the predicted weight of the fish at a given length from the summer RV survey was used as an indicator of the health of the fish. In 2001, the predicted weight of a 70 cm (adult) winter skate was 2.4 kg., which is the lowest in the series.

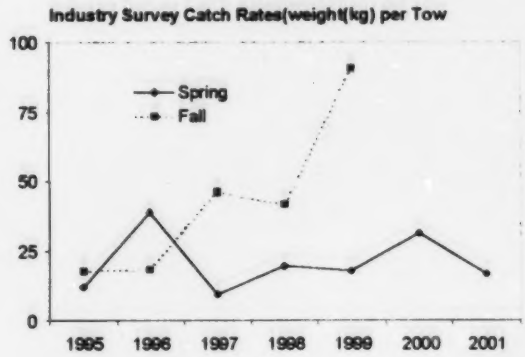


Relative Fishing Mortality, F (the ratio of catch divided by the summer RV biomass of winter skate) was calculated from 1977 to 2000. Relative Fs were high at the beginning of the directed fishery but have fallen as TACs have been reduced.

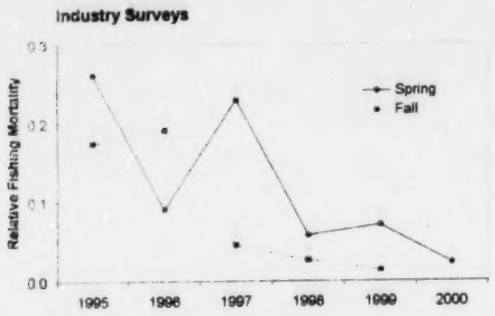


As part of the Conservation Harvesting Plan for skates established in 1994, industry initially conducted two (spring and fall) **industry/science skate directed-surveys** per year in Div. 4VsW. However, the fall survey was cancelled in 2000.

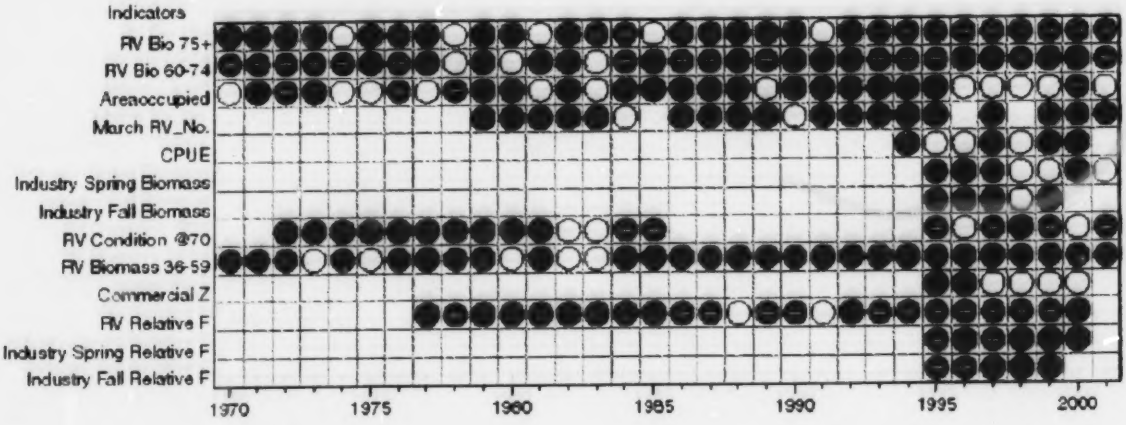
Winter skate **catch rate** (weight per tow) for the spring industry survey, in 2001, was 16.6 kg/tow, and provides no evidence of decline in the resource over the 1995-2001 period.



Relative Fs were calculated in the same manner as for the summer RV survey for the spring and fall industry surveys. The 2000 spring estimate was the lowest in the series.



The **Traffic Light** table that follows summarizes the indicators of stock status shown above. This table shows the annual values of each indicator as one of three lights depending on whether they are among the highest values observed for that indicator, among the lowest or in between. For indicators such as stock biomass and recruitment, high values are good and have a green light and low values are bad and have a red light. However, for indicators such as mortality, high values are bad and are assigned a red light● whereas low values are good and receive a green light●. Intermediate values are yellow○.



Outlook

The outlook from the last Stock Status Report (DFO, 2000) based on the assessment of the stock (Simon and Frank, 2000) included the following.

> "Long term data from the RV survey suggests that current levels of abundance and productivity are low. Industry data, available only since 1995, suggests that recent abundance has been stable. Skates are elasmobranches with slow growth and fecundity, life history characteristics, which make them susceptible to over exploitation. Hence fishing mortality should not be allowed to increase and continued monitoring is required."

Declines in several indicators from the new information available suggest that there are increased concerns for the status of this resource.

For More Information

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References

Branton, R., and G. Black. 2001. 2001 Summer Groundfish Survey update for selected Scotia Fundy groundfish stocks. DFO Canadian Science Advisory Secretariat Res. Doc. 2001/096.

DFO, 2000. Winter skate on the Eastern Scotian Shelf (4VsW). DFO Sci. Stock Status Rep. A3-29(2000).

DFO, 1999. Updates on Selected Scotian Shelf Groundfish Stocks in 2000. DFO Sci. Stock Status Rep. A3-35(1999).

Simon, J.E., and K.T. Frank. 2000. Assessment of the winter skate fishery in Division 4VsW. DFO Canadian Stock Assessment Secretariat Res. Doc. 2000/140.

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